National Oceanic and Atmospheric Administration
2015 NOAA SATELLITE CONFERENCE
Preparing for the Future of Environmental Satellites

Poster Session I
Tuesday April 28, 2015
10:30 AM & 3:00 PM

1-1   Enhance Climate Services from Space
Authors: Mitchell Goldberg, Wei Guo & Felix Kogan

In the recent two decades, the role of satellite observations for climate services increased considerably, especially with the introduction of the new generation of NOAA operational satellites, called Suomi Polar-Orbiting Partnership (S-NPP) and, which will continue as the Joint Polar Satellite System (JPSS) for the next two decades. The Visible-Infrared Imaging Radiometer Suite (VIIRS) is accommodating the best technical and scientific features of its predecessors and has many new important features. SNPP and JPSS will address the impacts of climate and weather on industries, water, energy, population health, and other resources and activities. This presentation will discuss how these operational satellites improve early drought detection, monitoring its features (intensity, duration, area etc) and prediction of agricultural losses; how fast Earth natural resources deteriorate; if the current warm climate intensifies droughts and increase its area and duration. These climate services have already become available to global community (http://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/index.php). We will also focus on continuity of space observations and development of several decades of data records.

1-2   NOAA Operational Oceanic Heat Content Product Suite
Authors: David Donahue, Eileen Maturi, Nick Shay, Jodi Brewster & Jerry Guo

In September 2012, the National Oceanic and Atmospheric Administration (NOAA) and the National Environmental Satellite Data and Information Service (NESDIS) began providing operational satellite derived ocean heat content (OHC) measurements. The satellite derived ocean heat content is a measure of the integrated vertical temperature from the sea surface to the depth of the 26°C isotherm and is computed from altimeter-derived isotherm depths in the upper ocean relative to 20°C based on a hurricane season climatology and a two layer ocean model. Product generation requires data from at least two satellite altimeters and the daily Sea Surface Height Anomaly updates from the U.S Navy Altimeter Processing System.

In the present model, the OHC estimates are calculated from 5 km resolution sea surface temperatures (SST) obtained from NESDIS GEO-POLAR Blended SST Analyses (Harris and Maturi, 2012) combined with Jason-2 and SARAL altimeter estimates of the 20°C and 26°C isotherm depths derived from a reduced gravity scheme using a daily ocean climatology of mean isotherm depths and reduced gravities. Based on a mean ratio between the 20 and 26°C isotherm depths, the depth of the 26°C isotherm and the ocean mixed layer depth are inferred. By integrating the 26°C isotherm depth to the surface (where SST is the surface boundary condition) an ocean heat content is calculated. The product fields are evaluated monthly when thermal structure data from various platforms become available such as Argo floats, XBT transects, mooring measurements, and airborne profiling from NOAA research aircraft. Satellite derived OHC is currently produced operationally for the North Atlantic and North Pacific. Efforts are underway to add data from the Cyrosat-2 SIRAL altimeter and expand coverage to the South Pacific and Indian Oceans.

1-3   Influence of Terrain Characteristics on Surface Radio Refractivity Variations over North Central, Nigeria
Authors: Ajileye O. O., Kolawole I. S. & Alaga A. T.

This paper investigates the interaction between terrain characteristics and surface refractivity during the past decades across North Central, Nigeria. Some issues were addressed in the study: seasonal variation of surface refractivity over a period of 22 years (1983 – 2005), spatial distribution of surface refractivity covering meteorological stations spread across the Nigerian middle belt and relationship between terrain features and spatial variation of surface refractivity. Satellite measurement of meteorological parameters comprising of temperature, relative humidity and pressure at 2 m and 10 m heights (relative to the surface) were obtained from National Aeronautic Space Administration (NASA) and used to compute mean and standard deviation of surface refractivity over the period. The results of surface refractivity were interpolated and compared with North Central terrain features to establish a correlation.

1-4 Use of Satellite Derived Data to Study the Characteristics of Thunderstorm Clouds in Kenya

Author: Elisha Chanzu

Weather occurrences from thunderstorm clouds present many challenges to human life. This includes the aviation hazards, flooding, the killer thunder and lightning among others. Weather events in the air may be likened to earthquakes on the ground and tsunamis in the oceans. Though these clouds are a manifestation of nature understanding their nature and behavior can makes mitigation against their impacts manageable.

This research focuses on western Kenya because of the high frequency of thunderstorm clouds in this region of Kenya. These thunderstorm clouds are believed to be the cause of the many weather related inconveniences to the people of this region.

This research aims to improve aviation safety, mitigation against flooding and reduction of deaths from thunder and lightning among many others.

The research method employed was by using composite differencing of wavelength channels to isolate areas with deep convection (thunderstorm clouds). The differencing was as follows: For daytime convection, Red 5-6, Green 4-9 and Blue 3-1. For night time convection, Red 10-9, Green 4-9 and Blue 9-0. The isolated thunderstorm clouds were then studied their evolution and their movement tracked.

The correlation between the observed days with thunder and the thunderstorm clouds derived from satellite data was calculated and a high correlation of 0.68 found.

1-5 Total Operational Weather Readiness - Satellites (TOWR-S) Project

Authors: Eric M. Guillot, Michael W. Johnson, Joesph K. Zajic, R. Bradley Pierce, & Brian S. Gockel

The Total Operational Weather Readiness – Satellites (TOWR-S) project is a joint GOES-R/JPSS/National Weather Service (NWS) project designed to assess the usability of both GOES-R and JPSS satellite data with respect to the NWS mission. Specifically, TOWR-S focuses on GOES-R, SNPP/JPSS, and Himawari satellite data integration within the Advanced Weather Interactive Processing System (AWIPS-II) in order to optimize its use for operations. In addition, data flow back to source is explored to identify deficiencies and help define optimum dissemination paths. A representative subset of high-impact NWS use cases are derived from the NWS Directives These use cases are developed via virtual coordination between NWS operational meteorologists (typically a Science & Operations Office or Satellite Focal Point) and the TOWR-S meteorologist (Eric Guillot) at NWS Office of Science & Technology. There are nine use cases currently in-work, including Severe Thunderstorm Warning with WFO Charleston, Hurricane Warning with the National Hurricane Center, and Red Flag Warning with WFO Eureka. Approximately 15-20 use cases will be pursued in TOWR-S and will be published for operational comment and further development via the NWS Virtual Laboratory.

In addition, the TOWR-S project is coupled to AWIPS satellite-display development and satellite data dissemination in two important ways: First, a continuous-integration TOWR AWIPS lab has been established within NWS/OST, which allows for iterative development and testing of satellite data display and mission-integration activities. Second, the project is actively coordinating data dissemination needs with the AWIPS Program and the Integrated Dissemination Program / Ground Readiness Project (IDP/GRP) which are responsible for AWIPS development and NWS dissemination, respectively. Finally, TOWR-S activities are being coordinated with the NWS Operational Advisory Team (NOAT) and with the NWS Training Division in order to leverage TOWR-S activities for forecaster training development.

1-6 Overview of the GOES-R HRIT/EMWIN System and Impacts to the User Community

Authors: John Stephen Britton, Andrew Krepps and Jonathan Terrell

The next generation GOES-R spacecraft combines the existing LRIT and EMWIN broadcasts into a single HRIT/EMWIN signal broadcast. As a work assignment to the NESDIS Environmental Satellite Processing and Distribution System (ESPDS) contract, Solers is responsible for the development of the new HRIT/EMWIN system to ingest data stream content and produce the satellite broadcast to end users.

The new HRIT data rate is nearly three times as fast as the current LRIT system and will distribute a variety of data products to the user community, including images, data, and weather alerts. In addition to production and uplink of the GOES-R series HRIT data stream, ESPDS will fully replace the legacy LRIT processing system. ESPDS will produce the LRIT data stream for uplink to the GOES-N-O-P series spacecraft until the spacecraft series is fully decommissioned.

There are changes to the system that will impact the user community as the current LRIT processing system is transitioned to ESPDS and the GOES-R spacecraft becomes operational. ESPDS fully utilizes virtual channelization capabilities of the CCSDS standard and end users will have the capability to filter and process only pertinent data based on virtual channel ID. Some end users may require software and hardware updates for fully compatibility with the LRIT/HRIT/EMWIN data stream. Details of the changes in the new version of the

data stream format, speed and the impact to the user community will be presented.

End users will be able to use one integrated receive system to get DCS, EMWIN and HRIT information in the future. Access to higher resolution images, refreshed more often and enhanced weather alert information from EMWIN with repeated alerts for better reliability are just some of the new features of HRIT.

1-7   Comparison of CloudSat and TRMM radar reflectivities

Authors: K. D. Sindhu, G. S. Bhat

Comparison of reflectivity data of radars onboard CloudSat and TRMM is performed using coincident overpasses. The contoured frequency by altitude diagrams (CFADs) are constructed for two cases: (a) only include collocated vertical profiles that are most likely to be raining and (b) include all collocated profiles along with cloudy pixels falling within a distance of about 50 km from the centre point of coincidence. Our analysis shows that for both cases, CloudSat underestimates the radar reflectivity by about 10 dBZ compared to that of TRMM radar below 15 km altitude. The difference is well outside the uncertainty value of ~2 dBZ of each radar. Further, CloudSat reflectivity shows a decreasing trend while that of TRMM radar an increasing trend below 4 km height. Basically W-band radar that CloudSat flies suffers strong attenuation in precipitating clouds and its reflectivity value rarely exceeds 20 dBZ though its technical specification indicates the upper measurement limit to be 40 dBZ. TRMM radar, on the other hand, cannot measure values below 17 dBZ. In fact combining data from these two radars seems to give a better overall spatial structure of convective clouds.

1-8   R2-Whoa: Challenges and solutions for executing best practices in transferring NOAA's research to NWS operations

Author: Jordan Gerth

The National Oceanic and Atmospheric Administration (NOAA) has both research and operational missions. Critical to the success of the organization is the necessity to ensure that operational requirements drive NOAA's research portfolio, but also that research byproducts are assured a permanent pathway to operations following an iterative cycle and successful demonstration. Recently, the concept of a proving ground has evolved as a conduit for research to operations (R2O) tasks to flourish.

NOAA funds cooperative institutes to undertake a large but diverse set of research tasks. Recent efforts have focused on better aligning research with operational priorities. For example, the Geostationary Operational Environmental Satellite R-Series (GOES-R) and Joint Polar Satellite System (JPSS) programs utilize the National Weather Service (NWS) Operational Advisory Team (NOAT), consisting of regional Scientific Services

Division (SSD) chiefs, to develop operational needs and review research proposals pursuant to those needs. Those proposals are asked to include a NWS collaborator that assists with the proposed plan to transition the research to operations.

While this alignment seems ideal for closing the R2O gap, the implementation of it has proven more challenging. The most significant challenge is sustaining an increased level of effort and focus on both sides. In addition, NOAA's R2O process requires operational leadership to become decision makers about research priorities. While operational leaders are attune to the priorities of their organization, their backgrounds and experiences generally do not immediately enable them to establish reasonable expectations for deliverable research.

In contrast, the research side is frustrated with devoting time and funds to a transition process that is complicated with information technology hurdles and misunderstandings about how their research byproduct may be used. For example, as part of the proving ground, cooperative institutes are asked to support their research byproducts in the Advanced Weather Interactive Processing System (AWIPS), a complex software package not readily available in research environments, during pre-operational demonstrations. Even after a successful demonstration, it takes substantial time before a product graduates to routine production and operational monitoring, essentially completing the R2O process.

GOES-R and JPSS have invested in satellite liaisons to help bridge the gap. However, while these liaisons play an important role in teaching the operational meteorologists about new GOES-R and JPSS science products and organizing product demonstrations, their alignment is closer to the operations side where their offices exist. The role of the satellite liaison is also new and evolving to fit the needs of operations, where satellite meteorology subject-matter expertise is currently lacking.

This presentation will discuss longstanding challenges with the R2O process, particularly from the satellite meteorology research perspective, including solutions for averting R2-Whoa scenarios. Accomplishments and best practices from the GOES-R and JPSS satellite proving ground are highlighted, and future potential directions promoted, based on pitfalls from the past. The intent is to build a robust R2O process between and within NOAA and its partners."

1-9   NOAA's Joint Polar Satellite System's Proving Ground and Risk Reduction Program – Bringing New Capabilities to Operations

Authors: Mitchell Goldberg & William Sjoberg

This presentation will focus on the NOAA Joint Polar Satellite System (JPSS) Program's Proving Ground and Risk Reduction (PGRR) initiative and how it has prepared NOAA users to effectively utilize new polar-orbiting capabilities. The PGRR Program was established in 2012, following the launch of the Suomi National Polar Partnership (SNPP) satellite. Over 40 projects have been funded since the PGRR Program was established. Details about how these projects have been continually tailored through the years to meet user requirements, will be highlighted. The presenter will focus on the procedures established to facilitate PGRR project teams work with their users to evaluate these new capabilities in their operational environments and, those procedures established to transition these capabilities into operations. Details on the Dec 2014 PGRR Call-for-Proposals and the responses will be discussed.

1-10   An analysis of the Dependence of Global Temperature Anomaly on Solar Activity and Carbon Dioxide Concentration

Author: Benjamin Ayantunji, Kingsley Orisekeh

The dependence of global temperature anomaly on solar activity and carbon dioxide (CO2) was studied. The objective of the study was to established the contribution of these two parameters on the globally acknowledge warming of the atmosphere so as to established whether global warming is of anthropogenic causes or natural. To achieve this objective, data of sunspot number, CO2 concentration and global temperature anomaly from 1880 to 2014 was employed. The results obtained established shows that though both solar activity and CO2 concentration contribute to variation of global temperature anomaly, the effect of solar activity is often subsumed under the effect of CO2 concentration variation. The observed global warming from 1960 to date was solely attributed to increase in CO2 concentration because solar activity has been on the decrease over this period yet the global temperature anomaly has been increasing.

1-11   Operational implementation of the Linear Fit SO2 algorithm for use with S-NPP OMPS

Authors: Jianguo Niu, Zhihua Zhang, C. Trevor Beck, Lawrence Flynn & Kai Yang

The linear fit SO2 algorithm (NMSO2), implemented in an orbital processing mode for retrieving total amount atmospheric SO2 developed by NASA, has been transferred to STAR/NESDIS. For the sake of real time disaster monitoring, it is requested that SO2 amount are derived from the near real time processing. A 16-granule overlapping data requisition scheme was proposed to perform this task. It has a tradeoff between the need for large blocks of data to identify the reference residual and for smaller blocks of data to decrease latency or for use in direct readout applications. The data are selected so that the last eight granules of a previous 16-granule set overlapped with the first eight granules of the

consecutive 16-granule set. This provides sufficient data to make good estimates of the reference residual for the middle eight granules. The SO2 linear fit algorithm has been implemented as a module of the Version 8 total column ozone algorithm in use at STAR. The ozone retrieval algorithm was modified from the single granule processing into 16-granule processing. As a validation, we implemented NASA orbital and STAR 16-granule NMSO2, and selected Bardarbunga volcano eruption event on September 4, 2014 to validate their global SO2 retrievals. It was found that both algorithms provide similar SO2 global distribution, but their values from STAR are about 3 times lower than that of NASA over the regions with high SO2 loading. Further investigation identified a small typographical error in NASA code and it has been corrected. After this correction both NASA and STAR provide similar retrieval values with smaller differences which can be attributed to the new scheme developed at STAR for determination of the reference residual. The comparison displayed that after NASA code correction and the new reference residual determination scheme being used, the SO2 values from both STAR and NASA are similar, and almost all artificial structures existed in NASA current retrieval have been significantly reduced. Finally, two volcano eruption monitoring cases using 16-granule scheme are shown.

1-12   New Metsat Display for National Weather Service Satellite Imagery

Authors: Robert Gillespie, Bill Bergen & Sterling Weem

The National Weather Service seeks to improve the usability of satellite imagery provided on its website. The Service seeks to make the data and images more accessible to non-scientific users and to be more useful in supporting decision makers needing weather information. Carr Astronautics has developed a new viewing application under a NOAA SBIR that integrates satellite imagery with other data and produces a rich, user-controlled view of imagery and allows the weather data to be applied to a variety of commercial, governmental and personal decision making scenarios.

1-13   The Argos Data Collection and Location System

Author: Scott Rogerson

The Argos Data Collection & location System (DCS) is administered under a joint agreement between the National Oceanic and Atmospheric Administration (NOAA) and the French Space Agency, Centre National d'Etudes Spatiales (CNES). Additional partners include the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) and the Indian Space Research Organization (ISRO). There are currently over 21,000 active Argos Platforms being tracked by 1,900 users in more than 100 countries. An overview of the Argos system and diversity of user applications will be provided – with a focus on recent and planned improvements to the overall system.

1-14   Assessment of GOES-R Product Potential Benefits using the NOAA Observing System Integrated Analysis II (NOSIA-II)

Authors: Louis Cantrell, David Helms, Robert Reining & Aaron Pratt

This is a NOAA Observing System Integrated Assessment II (NOSIA-II) sensitivity analysis that examines how incremental improvements in product data sources can translate into measurable benefits to each of NOAA's Mission Service Areas (MSA). This sensitivity analysis is targeted at NOSIA surveyed product improvements enabled by GOES-R. This analysis can recommend GOES-R program product development priorities in order to deliver the greatest benefit to the MSAs as quickly as possible. The Objective of the study is to collaborate with the GOES-R Program Office to identify the GOES-R products with the greatest potential benefit to the MSAs and to estimate the maximum potential benefit derived from these products. The approach is accomplished in 5 steps. First, for each GOES-R product, use NOSIA-II to produce a list of MSA benefit scores due to an incremental improvement to a GOES-R relevant data source. Second, sort the MSA benefit deltas (difference between improvement and baseline) to identify the most impactful GOES-R product. Third, filter this list to retain only those GOES-R products which have the greatest potential benefit improvement on MSAs. Fourth, present this filtered list to the GOES-R Program Office and obtain Subject Matter Expert estimates of maximum potential improvements to NOSIA Product data source overall satisfaction scores for those GOES-R relevant data sources. Finally, incorporate these maximum potential improvements into the NOSIA-II model and estimate the maximum potential benefit derived from these products.

1-15   Recalibration and merging of SSU observations for stratospheric temperature trend studies

Authors: Cheng-Zhi Zou, Haifeng Qian & Likun Wang

Long-term observations from the Stratospheric Sounding Unit (SSU) during 1979–2006 onboard NOAA historical polar orbiting satellites were recalibrated for climate change investigation. A two-point linear calibration equation, with cold space and an internal blackbody warm target as end-point references, was used to transfer SSU raw counts data into radiances. The warm target temperature was represented by measurements from the space side thermistor on the blackbody. Space view corrections due to an electrical interference were applied. Intersatellite calibration was conducted simultaneously by applying calibration offsets determined from residual intersatellite biases. The recalibration reached an accuracy of 0.1–0.2 K for global means and thus is expected to improve the consistency

in stratospheric temperature time series in climate reanalyses. The recalibrated SSU radiances were further adjusted to develop Version 2 of the NOAA stratospheric temperature time series. The effects being adjusted included those from changes in instrument cell pressure and atmospheric carbon dioxide concentration, viewing angle differences, and semidiurnal tides due to orbital drift. Intersatellite biases were carefully removed to ensure smooth transitions between satellite pairs. In addition to the final merged data set, intermediate synthetic time series corresponding to different adjustments were also created to quantify their impact on the final trend as well as its reliability and uncertainty. Excellent matching between satellite pairs, especially the 7 year overlaps between NOAA-11 and NOAA-14 during 1997–2004, in intermediate as well as the final time series provided strong evidence on the validity of adjustments and thus confidence on the resulting trends. The Version 2 global mean trends for 1979–2006 were -0.69 ± 0.18, -0.77 ± 0.15, and -0.85 ± 0.15 K/decade for SSU channels 1, 2, and 3, representing temperatures of middle stratosphere, upper stratosphere, and stratosphere-mesosphere, respectively. Finally, the average of the channel 1 and channel 3 anomalies in Version 2 was close to channel 2 anomalies to within 0.2 K for the entire 1979–2006 period with identical trends. This feature was found consistent with chemistry-climate model simulations.

1-16   Characterization of the Difference between Aerosol Retrievals from Multi-Sensors and AERONET

Authors: Jingfeng Huang, Hongqing Liu, Istvan Laszlo, Shobha Kondragunta, Lorraine A. Remer, Ho-Chun Huang, Hai Zhang, Stephen Superczynski, Maksym Petrenko, Brent N Holben, Robert C Levy, Ralph A Kahn & Charles M Ichoku

Comparing Suomi-NPP VIIRS aerosol retrievals to AERONET ground measurements plays a vital role in evaluating the maturity status of the VIIRS aerosol products. The study applied the Multi-sensor Aerosol Product Sampling System (MAPSS) to compare VIIRS aerosol products and the heritage MODIS (C5.1 & C6) and MISR aerosol products with AERONET measurements over the VIIRS's operational period. The accuracy and precision of the VIIRS aerosol products, as determined by comparison with AERONET measurements, were evaluated against JPSS-1 performance evaluation threshold values. Regional, seasonal and geometrical dependence of the deviation of the satellite retrievals from the ground measurements were characterized and compared. Results indicate comparable performance of the VIIRS aerosol optical depth EDR and Ångström Exponent EDR (over ocean) to their counterparts from the heritage sensors. The findings on the spatial and temporal patterns of the differences between the satellite aerosol retrievals and AERONET will aid in the improvement of the VIIRS

aerosol products as we transition from NPP to the JPSS-1.

1-17 Algorithm to Detect Dust and Smoke in Suomi-NPP VIIRS Imagery

Authors: Shobha Kondragunta & Pubu Ciren

Suomi-NPP Visible Infrared Imaging Radiometer Suite (VIIRS) was launched on October 28, 2011 to provide various atmospheric and land related environmental parameters to the operational user community. An automated method to identify smoke and dust plumes in the VIIRS imagery is important for a host of applications including air quality monitoring and forecasting. We developed an algorithm that uses spectral and spatial variability tests to determine smoke and dust aerosol indices. This algorithm has been tested on VIIRS granules (43 for dust and 23 for smoke) globally with known dust and smoke plume outbreaks and evaluated by comparing to Cloud Aerosol LIdar with Orthogonal Polarization (CALIOP) and AERosol Robotic NETwork (AERONET). Each VIIRS granule is a 86s data capture with 48 scan lines, 3000 km swath width, and 750 m to 1.2 km pixel resolution. In this study, first by taking advantage of the strong spectral dependence of the absorption by smoke/dust at shorter wavelengths, such as 410 and 440nm, an index, named as Dust aerosol Index (DAI) was developed to detect smoke and dust. Secondly, due to that fact the particle size of dust is considerably larger than that of smoke, consequently leading to a strong signal at shortwave IR for dust but not for smoke, another index, named as non-dust aerosol index (NDAI) was developed to separate smoke from the dust. and smoke. Comparisons with AERONET observations and CALIOP VFM product indicated that the accuracy of aerosol detection (smoke and dust) is found to be 75% over land and 82% over ocean.

1-18 Inter-calibration and validation of observations from modern satellite microwave humidity and temperature sounders

Authors: Isaac Moradi & Ralph Ferraro

We present the results of evaluating observations from microwave instruments aboard the Suomi National Polar-orbiting Partnership (NPP, ATMS instrument) and Megha-Tropiques (SAPHIR instrument) satellites. ATMS is a cross-track microwave sounder that combines the capabilities of the previous microwave temperature and humidity sounders, i.e. Advanced Microwave Sounding Unit (AMSU-A and -B) and Microwave Humidity Sounder (MHS), aboard NOAA's Polar-orbiting Operational Environmental Satellite System (POES).

ATMS is planned to fly on the United States next generation polar-orbiting operational environmental satellite system named as the Joint Polar Satellite System (JPSS). This sensor is currently flying on the Suomi National Polar-orbiting Partnership (S-NPP) satellite, launched in October 2011, which is in a Sun-

synchronous orbit with the ascending equatorial crossing time at 01:30 a.m. Megha-Tropiques, launched in Nov 2011, is a low-inclination satellite meaning that the satellite only visits the tropical band between 30 S and 30 N. SAPHIR is a microwave humidity sounder with 6 channels operating at the frequencies close to the water vapor absorption line at 183 GHz. Megha-Tropiques revisits the tropical regions several times a day and provide a great capability for inter-calibrating the observations with the polar orbiting satellites.

The study includes inter-comparison and inter-calibration of observations of similar channels from the two instruments, evaluation of the satellite data using high-quality radiosonde data from Atmospheric Radiation Measurement Program and GPS Radio Occultaion Observations from COSMIC mission, as well as geolocation error correction. The results of this study are valuable for generating climate data records from these instruments as well as for extending current climate data records from similar instruments such as AMSU-B and MHS to the ATMS and SAPHIR instruments.

1-19 Implementation of a network of ground stations via GOES purposes of early warnings of extreme hydroclimatic events in the Valle del Cauca - Colombia

Author: Oscar Ramirez

Atmospheric phenomena have become stronger and more frequent over the past several years due to the effects of climate change. Colombia's Pacific coast and the Valle del Cauca region has been one of the most affected areas in terms of extreme weather events, such as floods and droughts. CVC (the Valle del Cauca's regional government) has been updating its network of Hydro-meterological monitoring using GOES in order to improve early warning to Colombian society and various economic activities that are vulnerable to weather events. This early warning system will use satellite-based dissemination with several receive stations installed throughout the country. Colombia will use data from its own observing network as well as data from GEONETCast Américas. Data will be processed and analyzed by the FewsColombia system, which will issue early warnings at various levels of severity. Colombia will also make available, to any interested party, the country's database on climate data, containing 35 years of observations.

1-20 Jpss-1 Science Data Product Verification And Validation: Pre-Launch To Post-Launch Plans

Authors: Murty G. Divakarla, Lihang Zhou, Xingpin Liu, Walter Wolf, Eric Gottshall, Janna Feeley, Tom Atkins, Robert Steadley & Ray Godin

The Joint Polar Satellite System (JPSS)-1 (J1) satellite is scheduled to be launched in early 2017. The J1 and follow-on satellites will host an array of instruments

including the Visible Infrared Imaging Radiometer Suite (VIIRS), the Cross-track Infrared Sounder (CrIS), the Advanced Technology Microwave Sounder (ATMS), and the Ozone Mapping and Profiler Suite (OMPS). These instruments are similar to the instruments currently operating on the Suomi National Polar-orbiting Partnership (S-NPP) satellite, a predecessor designed to bridge for the JPSS constellation. Algorithms to process J1 instrument data into xDR products such as Raw Data Records (RDRs), Sensor Data Records (SDRs), and Environmental Data Records (EDRs) have been developed based on the experience gained through the S-NPP algorithms. Optimizations are also being performed on J1-Uppers, which account for future improvements to the instruments on J1 to produce additional or improved data products to meet the JPSS program requirements. These algorithms will be in operations through either the Interface Data Processing Segment (IDPS) or S-NPP Data Exploitation (NDE). Once these xDR products are verified to meet the requirements, they will provide continuity of capabilities for operational remote sensing of weather, climate and other environmental applications. To achieve this overarching goal, The JPSS STAR (JSTAR) program management team, in association with STAR cal/val teams has set up a Cal/Val activity plan using pre-launch test data sets and post-launch validation data sets. This paper presents an overview of the JPSS Cal/Val activities and science verification plans for the xDR requirements. This overview includes a discussion on the pre-launch test data sets, schedules, and their utility towards the pre-launch set-up of algorithms, as well as a discussion on synthetic/proxy data sets generated from S-NPP observations and their utility in optimizing the xDR algorithms. Lessons learned from the S-NPP post-launch product validations, proposed post-launch xDR product validation plans, and schedules for J1 are also discussed in this paper.

1-21   Subtropical and Tropical Frontal Passages: A Hawaii Perspective
Authors: Eric Lau & Jordan Gerth
Weather predictability in Hawaii and the surrounding tropical Pacific Ocean is uniquely challenging. Though the weather is generally pleasant, the lack of in-situ weather observations for monitoring the progress of fronts over the ocean makes for difficult wind, moisture, and occasionally temperature forecasts in Hawaii and surrounding areas. In addition, frontolysis can complicate timing and strength predictions as fronts makes southward progress. This, in turn, can decrease predictability for thunderstorms, heavy rainfall, surf regimes, and better air quality.

Along with developing a methodology for indicating a frontal passage based on station observations across the Hawaiian Islands, this presentation will investigate frontal passages over the Hawaiian Islands and provide insight about how new satellite imagery and products

can characterize these events, using recent examples from the Suomi National Polar-orbiting Partnership (NPP) satellite. The objective is to better understand and forecast subtropical and tropical frontal passages in marine environments.

1-22   Facilitating JPSS-1 algorithm development using EPL review process
Authors: Valerie Mikles, Kristina Sprietzer, Bigyani Das, Walter Wolf, Marina Tsidulko & Weizhong Chen
The NOAA/NESDIS Center for Satellite Research and Applications (STAR) Algorithm Integration Team (AIT) provides technical support of the Joint Polar Satellite System (JPSS) algorithm development and integration tasks in conjunction with the Data Products Engineering and Services (DPES) group. In addition to technical tasks, AIT facilitates the development of JPSS-1 algorithms by implementing a review process based on the Enterprise Product Lifecycle (EPL) process. Coordinating directly with the science algorithm teams, we have tailored the review process to minimize both scheduling and technical risks, and constructed a self-contained document suite to keep all stakeholders apprised of algorithm development decisions. STAR AIT also maintains configuration management on the algorithm and documents and has developed tools to more efficiently manage parallel content between the existing requirements and review documents. The review process, its implementation, and the content management shall be discussed.

1-23   STAR Central Data Repository (SCDR): An Integrated and Effective Framework for Satellite Data Acquisition and Dissemination
Authors: Weiguo Han & Joseph Brust
To support near and long-term goals of Center for Satellite Applications and Research (STAR) of National Oceanic and Atmospheric Administration (NOAA), an integrated and effective data repository framework titled STAR Central Data Repository (SCDR) is built to provide a stable, reliable, and continually available data source with various kinds of near real-time satellite datasets to research and product development teams for calibration, validation, simulation, production, and monitoring activities.

In the SCDR, custom programs and utilities are developed to fetch, manage, and locate the satellite data files. The massive amount of satellite and ancillary data are obtained (pushed or pulled) from providers through high speed internet connections. The management program distributes these files evenly to disks within a Network file System (NFS) environment that can be accessed freely by STAR users internally. And this program retrieves metadata information (like satellite, data type, size, begin and end date/time, etc) from the files with different formats, and ingests them into the partitioned tables in a core database. It is also

responsible for managing disk spaces and removing the expired files. Moreover, SCDR offers multiple easy and consistent interfaces to obtain satellite data of interest. A utility named scdr-files with multiple options is implemented to locate files of interest stored in the SCDR. In addition, a Web portal is built for internal users to search data of interest interactively and intuitively. And a lightweight RESTful Web service is developed as another option to list available datasets and search the specific files. This service can be easily consumed by command-line tools (such as wget or curl) or other programs across operating systems.

SCDR addresses satellite data requirements and data management needs of STAR researchers and scientists. It greatly saves their time on data collecting, storing, and searching, and reduces data latency and network traffic. Currently, SCDR provides 200 datasets (including more than 29,000,000 files with size over 300 TB) from NOAA-series, GOES-series, MODIS, Metop-A/B, DMSP, WindSat, and Suomi NPP satellite. According to our statistics from the logged requests, SCDR processes nearly 1,700,000 requests for about 3,000,000,000 files (approximately 57,000 TB) from STAR users every month. New observation datasets from the latest Himawari, Sentinel and GOES-R satellites are being and will be added in this scalable repository to meet ever more demanding research and development needs.

In summary, SCDR disseminates satellite data in a timely and efficient manner to STAR users, especially the calibration/validation and science monitoring teams, helps them generate better products and services for weather prediction, atmosphere, ocean and land surface monitoring, and extremely facilitates their primary research and development activities.

1-24 Preparing for imagery from the next generation of geostationary imagers
Authors: Mathew M. Gunshor, Timothy J. Schmit, Kaba Bah, Joleen Feltz & Tom Rink

The next generation geostationary satellite series will offer a continuation of current products and services and enable improved and new capabilities. The Advanced Baseline Imager (ABI) on the Geostationary Operational Environmental Satellites (GOES)-R series will monitor a wide range of phenomena. The Advanced Himawari Imager (AHI) on Himawari-8, operated by the Japan Meteorological Agency (JMA), is a similar instrument to the ABI and has been on-orbit since October 2014. As with the current GOES Imager, the ABI will be used for weather, oceanographic, climate, and environmental applications. The ABI will improve upon the current GOES Imager with more spectral bands, faster imaging, higher spatial resolution, better navigation, and more accurate calibration. The ABI expands from five spectral bands on the current GOES imagers to a total of 16 spectral bands in the visible (2), near-infrared (4) and infrared (10) spectral regions. There will be an increase

of the coverage rate leading to full disk scans at least every 15 minutes and continental US (CONUS) scans every 5 minutes. High-time resolution (1 minute) loops over mesoscale regions will also be possible. ABI spatial resolution (at the satellite sub-point) will be nominally 2 km for the infrared and most near-IR bands, 1 km for some visible and near-IR bands, and 0.5 km for the 0.64 um visible band. High-quality simulated data, as well as other satellite observations, are being used in a number of ways to prepare for the ABI validations as these data are now being used in the ground system to produce L1b and L2 imagery.

Details of the GOES-R Cloud and Moisture Imagery team recent activities will be presented and discussed. Proposals for ABI expanded scan scenarios, shifted CONUS scans, preparation for AHI, using AHI to prepare for ABI, and other operationally relevant issues that could affect users will be presented.

1-25 Direct Broadcast Software: CSPP and IMAPP Support for Operational Environmental Applications
Authors: Kathleen Strabala, Liam Gumley, Allen Huang, Graeme Martin, Scott Mindock, Ray Garcia, Nick Bearson, James Davies, Rebecca Cintineo, Elisabeth Weisz, Nadia Smith, Bill Smith Sr. & Brad Pierce

Near real-time direct broadcast products created from down-linked data from the polar orbiting meteorological satellites using NOAA JPSS Community Satellite Processing Package (CSPP) and NASA International MODIS/AIRS Processing Package (IMAPP) software are being used for a wide variety of global operational environmental applications including support of US National Weather Service (NWS) forecasters. This presentation will include an overview of current global real-time users and applications, but focus on the end-to-end production, distribution and use of products by the US National Weather Service. Keys to the success of this effort include the high quality of the data and products, high spatial and spectral resolution which complements the high temporal resolution of the GEO instruments, the rapid turnaround of direct broadcast from data acquisition to distribution, as well as user training and feedback.

1-26 Advancement of Satellite-Imager Based Overshooting Top (OT) Decision Support Products
Authors: Kristopher Bedka, Konstantin Khlopenkov, Sarah Griffin & Christopher Velden

An algorithm has recently been developed to objectively identify overshooting cloud top (OT) and enhanced-V signatures using infrared brightness temperature (BT) patterns within thunderstorm anvil clouds in support of the GOES-R Aviation Algorithm Working Group. The algorithm has been successfully applied to MODIS, VIIRS, AVHRR, and geostationary imagery for diagnosis

and nowcasting of hazardous convective weather and for development of long-term regional OT databases that highlight spatial and temporal variability in deep convective storm activity. However, use of fixed thresholds and other algorithm constraints can cause warm-topped storms or those with weak overshooting magnitude to go undetected which can limit product utility in forecast operations and inhibits generation of a climate data record of global hazardous storm detections.

A new GOES-R Risk Reduction Research Program project seeks to 1) improve upon the existing algorithm through the use of sophisticated pattern recognition techniques and enhanced use of numerical weather analysis data and 2) develop an improved methodology for assigning OT height. The net result of goal #1 is a probabilistic OT detection product that can be generated using data from any polar-orbiting or geostationary imager and be applied uniformly across any geographic region or season. The detection method has been tested on geostationary 1 km visible and ~4 km IR imagery as well as on MODIS imagery resampled to the same resolution. The algorithm uses a series of pixel-level tests to define a set of OT candidate regions via pattern recognition. The algorithm automatically determines the presence of a convective cloud via spatial analysis of the IR BT field and looks for prominent regions of anomalously cold BTs relative to the surrounding anvil. The magnitude of the OT-anvil BT difference can be combined with a characteristic cloud top lapse rate to assign OT height. A 2-D Fourier transform analysis is used to identify highly textured regions associated with OTs and gravity waves depicted in visible imagery. The differences between the candidate OT IR BT and NWP level of neutral buoyancy and tropopause fields are also included. A set of statistically significant OT predictors are incorporated into a logistic regression model to derive a final OT probability for a given OT candidate. This presentation will provide an overview of the probabilistic OT algorithm and height assignment method, OT detection validation results, and examples of recent OT detection product applications.

1-27   Adaptive Trending and Limit Monitoring Algorithm for GOES-R ABI Radiometric Parameters

Authors: Zhenping Li, David Pogorzala, Ken Mitchell & J.P. Douglas

The trending and monitoring of radiometric parameters are critical aspects of GOES-R Advanced Baseline Imager (ABI) operations for monitoring instrument health and safety and maintaining data quality. Given that radiometric parameters for GOES imagers typically exhibit a diurnal behavior, an automated trending approach of simply calculating the mean and standard deviation of a parameter's time series is not optimal. Instead the value of a parameter at a given time needs to be compared with its value at the same times in previous days to determine if the data are following a consistent diurnal trend. An Adaptive Trending and Limit Monitoring Algorithm (ATLMA) is proposed to enable an automated capability to trend and monitor radiometric parameters exhibiting this diurnal behavior, and will be implemented in the forthcoming GOES-R ABI Radiometric Trending and Data Analysis Toolkit (GRATDAT) to assist in ABI radiometric monitoring and trending operations. ATLMA is intended to trend spacecraft telemetry data exhibiting a diurnal behavior, which allows the data to be expressed as a Fourier series. The algorithm is initially trained using recent data to establish a predictive model of the radiometric parameters as a function of time. Based on this model, dynamic limit monitoring of new data can be conducted in real time or near real time. The initial training consists of an iterative and weighted least-square fitting (LSQ) of previous data to obtain the coefficients of the Fourier expansion, as well as the standard deviations of the fit residuals. The algorithm begins by weighting each data point by 1.0 in the first iteration of the LSQ fitting, resulting in a set of predicted values for each data point as well as an initial set of Fourier expansion coefficients. A new set of weights is computed for each data point based on the magnitude of its residuals, and a second iteration of the LSQ fitting is performed to refine the Fourier coefficients. The standard deviation of the residuals to the second iteration of LSQ fitting defines the noise level of a data set. Long-term trends in the residual standard deviations may provide insight into potential performance degradation in the detectors. An outlier in such a limit-monitored data set is defined as any data point whose distance to its predicted value from the LSQ-fitted model is larger than a threshold, which is a user-defined multiple of the standard deviation obtained from the LSQ fit. Simulated results from applying ATLMA to the radiometric bias and gain calibration parameters from the currently-operational GOES N-P Imagers are presented. These results show that an outlier that would otherwise remain unidentified by a simple mean and standard deviation-based trending approach can be easily identified by ATLMA.

1-28   Evaluating VIIRS Land Surface Albedo: Validation and Intercomparison

Authors: Dongdong Wang, Shunlin Liang, Yuan Zhou & Yunyue Yu

Surface albedo is one standard Environmental Data Record (EDR) derived from VIIRS data. Surface albedo EDR consists of land surface albedo (LSA), sea ice surface albedo and ocean surface albedo. A direct estimation approach, based on extensively simulation of atmospheric radiative transfer and surface bidirectional reflectance distribution function (BRDF) modeling, is being used to generate LSA from VIIRS top-of-atmosphere signature over clear-sky land pixels. Since the launching of Suomi NPP, the LSA algorithm has gone through two major improvements. The anisotropy in surface reflectance is considered in the latest update

and preliminary validation results have demonstrated that the new look-up table (LUT) with BRDF could produce stable and better results. This study compiled a more comprehensive data set of global albedo measurements and attempted to provide a better evaluation of VIIRS LSA data. After a thorough examination, data at 35 sites, including AmeriFlux, BSRN, GC-Net and SURFRAD, were obtained. High spatial-resolution satellite imagery was then used to evaluate the spatial representativeness of the ground measurements. The analysis of spatial homogeneousness selected 25 sites for data validation. In addition to in situ data, VIIRS albedo was also compared with MODIS data. VIIRS and MODIS both produce high-quality surface albedo over non-snow pixels with root mean square error (RMSE) of 0.024 and 0.032 respectively. The VIIRS retrievals have a small negative bias of 0.006, whereas MODIS underestimate snow-free albedo by 0.026. For all the land cover types other than sparsely vegetated ground, VIIRS data have smaller bias and uncertainties. Compared to snow-free data, estimation of snow albedo generally faces more challenges. Both VIIRS and MODIS data significantly underestimate snow albedo. RMSEs of snow albedo are also much higher, twice greater than snow-free cases. The temporal filter can effectively exclude pixels affected by undetected cloud or cloud shadow. After filtering, bias of VIIRS retrievals is reduced from -0.039 to -0.023 and RMSE is reduced from 0.084 to 0.065.

1-29   Assured Weather Satellite Information Delivery
Authors: Kerry Grant, Shawn Miller, Michael Jamilkowski & Shawn Cochran

The National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) are jointly acquiring the next-generation civilian weather and environmental satellite system: the Joint Polar Satellite System (JPSS). The Joint Polar Satellite System will replace the afternoon orbit component and ground processing system of the current Polar-orbiting Operational Environmental Satellites (POES) managed by the National Oceanic and Atmospheric Administration. The Joint Polar Satellite System satellites will carry a suite of sensors designed to collect meteorological, oceanographic, climatological, and solar-geophysical observations of the earth, atmosphere, and space. The ground processing system for the Joint Polar Satellite System is known as the Common Ground System (JPSS CGS), and provides command, control, and communications (C3) and data processing and product delivery. As a multi-mission system, CGS provides combinations of C3, data processing, and product delivery for numerous NASA, NOAA, Department of Defense (DoD), and international missions, such as NASA's Earth Observation System (EOS), NOAA's current POES, the Japan Aerospace Exploration Agency's (JAXA) Global Change Observation Mission – Water (GCOM-W1), and DoD's

Defense Meteorological Satellite Program (DMSP).

Developed and maintained by Raytheon Intelligence, Information and Services (IIS), the CGS is a multi-mission enterprise system serving NOAA, NASA and their national and international partners. The CGS provides a wide range of support to a number of missions:

- Command and control and mission management for the Suomi National Polar Partnership (S-NPP) mission today, expanding this support to the JPSS-1 satellite and the Polar Free Flyer-1 mission in 2017

- Data acquisition via a Polar Receptor Network (PRN) for S-NPP, the Japan Aerospace Exploration Agency's (JAXA) Global Change Observation Mission – Water (GCOM-W1), POES, and the Defense Meteorological Satellite Program (DMSP) and Coriolis/WindSat for the Department of Defense (DoD)

- Data routing over a global fiber Wide Area Network (WAN) for S-NPP, JPSS-1, Polar Free Flyer-1, GCOM-W1, POES, DMSP, Coriolis/WindSat, the NASA Space Communications and Navigation (SCaN, which includes several Earth Observing System [EOS] missions), MetOp for the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), and the National Science Foundation (NSF)

- Environmental data processing and distribution for S-NPP, GCOM-W1 and JPSS-1

The CGS plays a key role in facilitating the movement and value-added enhancement of data all the way from satellite-based sensor data to delivery to the consumers who generate forecasts and produce watches and warnings. This presentation will discuss the information flow from sensors, through data routing and processing, and finally to product delivery. It will highlight how advances in architecture developed through lessons learned from S-NPP and implemented for JPSS-1 will increase data availability and reduce latency for end user applications, including the Global Forecast Models (GFS, NAVGEM, ECMWF) [NWS, DoD, International], Cloud Cover Analysis [USAF], Tropical Storm [NWS, USN, USCG], Soil Moisture [US Army, USDA], Ice Data [USCG, USN], and various unique missions, such as Forest Fire management and Post-Event Power Outage Assessments.

1-30   Maintaining JPSS Product Quality
Author: Kerry Grant, Wael Ibrahim, Kurt Brueske & Paula Smit

The National Oceanic and Atmospheric Administration (NOAA) and NASA are acquiring the next-generation weather satellite system: the Joint Polar Satellite System (JPSS). The JPSS satellites carry a suite of sensors to collect meteorological, oceanographic, and climatological observations of the Earth. The JPSS Common Ground System (CGS) processes satellite data from the satellites to provide Sensor Data Records (SDRs) and Environmental Data Records (EDRs) to NOAA.

CGS is currently processing and delivering SDRs and EDRs for first JPSS satellite (S-NPP) and will continue through the lifetime of the JPSS program. The EDRs for S-NPP are currently undergoing an extensive Calibration and Validation (Cal/Val) campaign. As changes migrate into the system, long term monitoring activities will track product quality and stability. Raytheon is supporting this effort through the development of tools, techniques, and processes that detect changes in product quality, identify root causes, and implement changes to the system to bring products back into specification. To provide a basis for this support, Raytheon developed a theoretical analysis framework for the maintenance of consistency and integrity of operational algorithm outputs. The framework abstracts the operationalization of the science-grade algorithm process currently in use. The framework consists of two data categories, benchmark and experimental, and two analysis variation categories, principle and non-principle. Experimental data advances to benchmark data iteratively as the operational algorithm baseline evolves. This framework led to the development of a process to assess, characterize (qualitatively and quantitatively) and accept updated operational algorithm outputs. By combining software and systems engineering controls, manufacturing disciplines to detect and reduce defects, and a standard process to control analysis, an environment to maintain operational algorithm maturity is achieved.

Since 2014, as the S-NPP Cal/Val effort continues, Raytheon has extended the tools, techniques and processes described above to realize additional efficiencies.

1-31   Rapid Algorithm Integration in the JPSS CGS
Authors: Kerry Grant, Shawn Miller & Michael Jamilkowski
The National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) are jointly acquiring the next-generation civilian weather and environmental satellite system: the Joint Polar Satellite System (JPSS). The Joint Polar Satellite System will replace the afternoon orbit component and ground processing system of the current Polar-orbiting Operational Environmental Satellites (POES) managed by the National Oceanic and Atmospheric Administration. The Joint Polar Satellite System satellites will carry a suite of sensors designed to collect meteorological, oceanographic, climatological, and solar-geophysical observations of the earth, atmosphere, and space. The ground processing system for the Joint Polar Satellite System is known as the Common Ground System (JPSS CGS), and provides command, control, and communications (C3) and data processing and product delivery. As a multi-mission system, CGS provides combinations of C3, data processing, and product delivery for numerous NASA, NOAA, Department of Defense (DoD), and international missions, such as NASA's Earth Observation System (EOS), NOAA's current POES, the Japan Aerospace Exploration Agency's (JAXA) Global Change Observation Mission – Water (GCOM-W1), and DoD's Defense Meteorological Satellite Program (DMSP).

CGS's data processing capability processes the satellite data from the Joint Polar Satellite System satellites to provide environmental data products (including Sensor Data Records (SDRs) and Environmental Data Records (EDRs)) to the National Oceanic and Atmospheric Administration and Department of Defense processing centers operated by the United States government.

The first satellite in the JPSS constellation, known as the Suomi National Polar-orbiting Partnership (S-NPP) satellite, was launched on 28 October 2011. CGS is currently processing and delivering SDRs and EDRs for S-NPP and will continue through the lifetime of the Joint Polar Satellite System programs.

The EDRs for Suomi NPP are currently undergoing an extensive Calibration and Validation (Cal/Val) campaign. As Cal/Val proceeds, changes to the science will need to migrate into the operational system. In addition, as new techniques are found to improve, supplement, or replace existing products, these changes will also require implementation into the operational system. In the past, operationalizing science algorithms and integrating them into active systems often required months of work. In order to significantly shorten the time and effort required for this activity, Raytheon has developed tools, processes, and techniques to enable rapid algorithm integration into the CGS. These include the Algorithm Development Library (ADL), the Algorithm Integration Framework (AIF) and the Accelerated Release Cycle (ARC). The ADL enables scientist and researchers to develop algorithms on their own platforms, and provide these to Raytheon in a form that can be rapidly integrated directly into the operational baseline. Over the course of the Suomi NPP Calibration/Validation campaign, numerous participating scientists have adopted the ADL to ensure rapid transition of their updates into the operational system. Their feedback has been the driver to numerous improvements in the tool, many of which are seen in the latest release (ADL 4.1). As the JPSS CGS is a multi-mission ground system, algorithms are not restricted to Suomi NPP or JPSS missions. The ADL provides a development

environment that any environmental remote sensing mission scientist can use to create algorithms that will plug into a JPSS CGS instantiation. Supplementing ADL is the AIF. AIF allows Raytheon to integrate binary algorithms directly into the operational system, without modification of the original source code. This technique is used primarily with legacy algorithms with a history of successful operations on other systems. Finally, the Accelerated Release Cycle provides a stable, rapid release cycle into the operational system providing for shorter cycle times between science updates and operations. This paper describes the tools and processes CGS has implemented to speed the science to operations implementation process.

1-32 Validation of JPSS S-NPP VIIRS Surface Type Environmental Data Record

Authors: Rui Zhang, Chengquan Huang & Xiwu Zhan

The accurate representation of actual terrestrial surface types from regional to global scales is an important element for many applications. JPSS S-NPP VIIRS surface type environmental data record (EDR) product provides consistent global land cover classification data, which inherited the development of land cover products from the NASA's MODIS mission. The VIIRS surface type EDR is still in development, and the validated 1 stage algorithm maturity review has passed. This study introduced the process of validating the global surface type classification map and verifying the implementation of quality flags in the surface type EDR product. A visual interpretation based validation process was employed to quantitatively measure the accuracy of the classification map. Approximately 5000 ground pixels were picked by stratified random sampling and validated in an integrated validation tool, which dynamically extracts high resolution satellite images from web services, such as Google Map and Google Earth, to help the interpretations of the land cover type of the ground truth. The validation results showed that 73.92% classification accuracy has been achieved, which exceeds the 70% threshold in the level 1 requirement. The implementation of the quality flags are also verified, which suggests the surface type EDR data is ready to move forward to the next phase development.

1-33 Innovating Accelerated Use of NOAA Satellite Data – The Development of Accelerator-based Models and Applications

Authors: Allen Huang, Bormin Huang, Jarno Mielikainen & Melin Huang

In the past 5 years scientists and engineers at SSEC have devoted their ingenuity to leveraging high-performance "accelerator" technology of the NVIDIA Graphic Processing Unit (GPU) and, more recently, the Intel Many Integrated Core (MIC) to advance satellite and weather forecasting applications. In 2014 this SSEC team, located at University of Wisconsin-Madison, was selected as one of the Intel Parallel Computing

Centers (IPCC). In 2015 SSEC received an award from NVIDIA to develop a hybrid CPU-Fortran and GPU-CUDA weather forecasting model; to demonstrate the impact of a highly accelerated radiative transfer model and to pave the way for timely, frequent, and optimal use of the large volume of current and next generation NOAA Low Earth Orbit (LEO) and Geosynchronous Equatorial Orbit (GEO) data.

In this presentation we review the successful implementation of GPU-based high-performance radiative transfer models, such as CRTM, RTTOV, and RRTMG, running on NVIDIA GPUs via CUDA (Compute Unified Device Architecture). We continue with a review of the progress made so far in the development of a GPU based high-performance Weather Research Forecasting (WRF) model and demonstrate the design of a complete end-to-end GPU-CUDA WRF version, which could deliver a performance boost estimated to be much greater than a 10X speedup with respect to a single, modern CPU core.

We conclude by reporting on our recent efforts and our longer term plans for the use of Intel MIC Xeon Phi and NVIDIA GPU-CUDA accelerator technology in high performance computing (HPC). Specifically we address advancing and promoting broad and optimal use of large volume of NOAA and international satellites for not only weather forecasting applications but also for Observing Satellite Simulation Experiments (OSSEs) which are known to require tremendous computing resources.

1-34 Comparison of Different Calibration Approaches in S-NPP CrIS Full Spectral Resolution Processing

Authors: Yong Chen, Yong Han, Likun Wang, Denis Tremblay, Xiaozhen Xiong, Xin Jin & Fuzhong Weng

The Cross-track Infrared Sounder (CrIS) on Suomi National Polar-orbiting Partnership Satellite (S-NPP) is a Fourier transform spectrometer. It provides a total of 1305 channels in the normal mode for sounding the atmosphere. CrIS can also be operated in the full spectral resolution (FSR) mode, in which the MWIR and SWIR band interferograms are recorded with the same maximum path difference as the LWIR band and with spectral resolution of 0.625 cm-1 for all three bands (total 2211 channels). NOAA operated CrIS in FSR mode from normal mode on December 4, 2014 for S-NPP, and will operate CrIS in FSR mode for the Joint Polar Satellite System (JPSS). Based on CrIS Algorithm Development Library (ADL), CrIS full resolution Processing System (CRPS) has been developed to generate the FSR Sensor Data Record (SDR). This code can also be run for normal mode and truncation mode SDRs.

Since CrIS is a Fourier transform spectrometer, the CrIS SDR need to be radiometrically and spectrally calibrated. The current calibration approach does the radiometric

calibration first, and then applies the correction matrix operator (CMO), which includes the post calibration filter, spectral resampling, self-apodization removal and residual ILS removal, to the spectral calibration. In order to select the next calibration algorithm for JPSS-1, different calibration approaches are being implemented in the ADL full resolution code. Results show significant ringing artifacts among different calibration approaches and their order in the calibration process. The CrIS SDR Science team has been working to improve SDR calibration algorithm to reduce ringing artifacts, and we will implement and test the improved calibration algorithms for J1.

1-35   Feasibility of FENGYUN-3B VIRR and METOP-B AVHRR to Detect Large Fires Based on TERRA & AQUA MODIS and SNPP VIIRS Measurements
Authors: Molina, V., Sanz, J., Salvador, P., García, M. & Casanova, J.L.

Real-time fire detection is one of the most important final products obtained by Earth observation satellites, as moderate resolution imagery from heliosynchronous satellites provides firefighting forces with a reliable source of land information at least twice a day. Currently, MOD14/MYD14 algorithm from Terra and Aqua satellites has obtained good results in detecting large fires, and VIIRS Active Fires algorithm from Suomi NPP, developed as a part of the International Polar Orbiter Processing Package (IPOPP), behaves similarly to MOD14/MYD14. The main problem is associated to the satellites revisit time: the number of satellites used in fire detection, the more number of available fire products.

In this paper, a fire detection assessment in Northeast China during the most fire-active months of 2014 is made, using Global Fire Spot Monitoring (GFR) from Chinese Fengyun-3B VIRR, and the results of well-established algorithms for fire detection applied to Level 1B data from EUMETSAT METOP-B; in both cases MODIS and VIIRS fire detection products are used as a reference. This analysis allowed us to stablish those conditions and limits in which Chinese and European satellites, respectively Feng Yun and Metop, can be used as a trustworthy complement to current fire detection standard products.

1-36   Research to Operations of New and Enhanced NESDIS Satellite Products
Authors: Stacy Bunin, Tom Schott & Bonnie Reed

The National Environmental Satellite, Data, and Information Service (NESDIS) supports research to operations efforts that result in improved weather forecasts, assist in monitoring of Earth's climate and oceans, and provide timely access to atmospheric, oceanic, and land surface satellite data. Products are generated from domestic and international polar-orbiting and geostationary satellites to satisfy end user requirements. New and enhanced products from existing satellite systems and new products from new satellite systems are generated as operational user requirements are identified and validated and product development resources are secured. This poster will describe the research to development process, show recent examples of product development efforts that have successfully transitioned from research to operations, and highlight some products that are currently in the transition process.

1-37   NOAA's Operational Surface Temperature Products and their Applications
Authors: Eileen Maturi, John Sapper, Andy Harris, Jonathan Mittaz, Prabhat Koner, Alex Ignatov, ziaofang Zhu, Daniel Comarazomy & Jeehye Han

The National Oceanic and Atmospheric Administration's (NOAA) office of National Environmental Satellite Data and Services (NESDIS) generates operational geostationary, polar orbiting, and Microwave SST analysis to satisfy the requirements of users. NOAA provides SST products from GOES E/W, MTSAT-2 and MSG-2 and S-NPP VIIRS and MetOp-B (AVHRR) and AMSR2 as part of their routine operations.

New analyses are being generated on an operational basis. These analyses combine the geostationary (GOES-E/W, MT-SAT and Meteosat) SST, S-NPP VIIRS and MetOp-B (AVHRR) SST, and AMSR2 SST data into single high-resolution (0.05°×0.05°) daily global products. These products are 5km global day/night, nighttime only analysis and a diurnally corrected operational daily global 5km SST analysis for day/night and nighttime.

We have reprocessed both the 5km day/night and nighttime only blended SST analyses from September 2004 forward. We are currently reprocessing 1994 to September 2004.

Future SST retrievals that will be incorporated into the 5km daily global SST analyses are the Himawari-8/9 (Japanese), INDSAT-3D (Indian), and the SLSTR (European) sea surface temperture retrievals.

These temperature products are used by Coral Reef Watch to generate products for Bleaching and Alerts for coastal managers. The management of Mammals and fisheries by the National Marine Fisheries offices. The Oceanic Heat Content products for the national weather service for Hurricane and Typhoon intensity for the Atlantic and Pacific Basins. We are also developing a capability to generate high-resolution ocean currents by assimilating our operational Level 2 SST products into a configuration of the ROMS model. A reprocessing of radiance data holdings for geostationary sensors using our latest SST algorithm is furthering climate applications.

1-38   Improving Noah LSM Performance using Near Real Time Surface Albedo and GVF

Authors: Jifu Yin, Xiwu Zhan, Christopher R. Hain, Li Fang & Jicheng Liu

The Noah land surface model (LSM) uses multi-year climatology of monthly green vegetation fraction (GVF) and the multi-year averages of land surface albedo data for various numerical weather predictions at National Centers for Environmental Predictions (NCEP) of National Oceanic and Atmospheric Administration (NOAA). However, these climatological GVF and albedo data can only prescribe the multiannual means and lack the ability to capture real time vegetation status and land surface condition. In this study, the impact of near real time GVF and albedo on Noah LSM (version 3.2) performances are examined against in-situ measurements of surface net long wave radiation (LWnet) and net short wave radiation (SWnet) from 7 U.S. Surface Radiation Budget Network (SURFRAD) stations, and soil temperature (LST) and soil moisture (SM) from 179 USDA Soil Climate Analysis Network (SCAN) sites. Large differences between the near real time GVF/surface albedo and their multiple year averages are found on global domain with the seasonal characteristics. These differences have significant influences on Noah LSM simulations. With respect to in-situ measurements, Noah LSM performance improvements from assimilating the near real time GVF and albedo data could be up to 9.3% (11.04%) for surface (root-zone) soil moisture, 1.25K (0.8 K) for surface (root-zone) soil temperature, and 9% (4.2 Wm-2) for net radiations for time period longer than one week during 2001-2011 analysis periods. These improvements can significantly enhance drought monitoring capacity of Noah land surface model.

1-39   Evaluating the inter-FOV radiance difference of S-NPP CrIS Full Spectral Resolution Data Product

Authors: Xin Jin, Yong Han, Likun Wang, Denis Tremblay, Xiaozhen Xiong & Fuzhong Weng

Hyper-spectral radiances collected from space platforms are widely used for climate studies. The Cross-track Infrared Sounder (CrIS) on Suomi National Polar-orbiting Partnership Satellite (S-NPP) is the new candidate of critical instrument for climate study due to its very low noise features. It has been switched to the full spectral resolution (FSR) mode since Dec 04, 2014. NOAA/STAR has routinely produced the FSR SDR products with spectral resolution of 0.625 cm-1 for all three bands (total 2211 channels).

The pixels selected for the evaluation of inter-FOV radiance difference are nadir field-of-regards (FORs) on clear sky scenes over nighttime tropical oceans. The results show some different features comparing to the normal resolution SDR products. For mid-wave and short-wave bands, some of the differences are due to the increased spectral noise after switching to full-resolution mode. For long-wave band, the differences are due to the implementation of improved calibration algorithms. We are focusing on the remaining unknown causes.

1-40   Physical retrieval of ocean surface wind speed and its application to Typhoon analysis using passive microwave satellite remote sensing

Authors: Sungwook Hong, Hwa-Jeong Seo & Sang-Jin Lyu

Trends in intensities and peak wind speed of typhoon across the western North Pacific basin have increased recently in this region. Information related to the eye and center of a TC together with the intensity and wind field (radius of maximum wind) are important factors used in analysis of typhoons. We developed a sea surface wind speed retrieval algorithm for use in both rainy and rain-free conditions. This algorithm is based on a combination of satellite-observed microwave brightness temperatures, sea surface temperatures, and horizontally-polarized surface reflectivities from the fast Radiative Transfer for TOVS (RTTOV), and surface and atmospheric profiles from European Centre for Medium-Range Weather Forecasts (ECMWF). Validation results of sea surface wind speed between the proposed algorithm and the Tropical Atmospheric Ocean (TAO) data shows that the estimated bias and RMSE for AMSR-2 6.9 GHz and 10 GHz bands are 0.09 and 1.13 m/s, and -0.52 and 1.21 m/s respectively. Validation of Typhoon analysis using this algorithm was compared with best-track data from the Japan Meteorological Agency (JMA), the Joint Typhoon Warning Center (JTWC), and the Cooperative Institute for Mesoscale Meteorological Studies (CIMSS) for typhoons that occurred in the northeastern Pacific Ocean throughout 2012–2013. Details of this wind speed algorithm and recent validation results will be presented and discussed.

1-41   RGB product for convective clouds using COMS satellite

Authors: Sungwook Hong, Yuha Kim & Sang-Jin Lyu

In the near future, next-generation geostationary (GEO) meteorological satellites, such as Himawari-8/9, GOES-R, and Geo-KOMPSAT 2A, will observe the Earth with 16 spectral bands with high spatial and temporal resolutions. RGB products using the geostationary meteorological satellites such as COMS, Himawari-8/9, GOES-R, and Geo-KOMPSAT 2A have an advantage for operational users because of their ability to compress multispectral information content without losing the information observed by the satellites. In this study, we will present a new RGB product for detecting convective clouds using infrared bands 6.75 µm, 10.8 µm, and 12.0 µm of the COMS. The threshold values of the RGB product for convection are given through the ground radar observations and the RGB product operated in EUMETSAT. This RGB product is then applied to

analyze the center positions of Typhoons Danas and Francisco in 2013 and typhoons Neoguri and Halong in 2014. Details of characteristics of RGB convective cloud product and validation results in comparison with best-track data will be presented and discussed.

1-42 Vertical structure of radar reflectivity in deep intense convective clouds over the tropics
Authors: Shailendra kumar & Dr. G.S. Bhat

This study is based on 10 years of radar reflectivity factor (Z) data derived from the TRMM Precipitation Radar (PR) measurements. We define two types of convective cells, namely,
cumulonimbus towers (CbTs) and intense convective clouds (ICCs), essentially following the methodology used in deriving the vertical profiles of radar reflectivity (VPRR). CbT contains $Z \geq 20$ dBZ at 12 km height with its base height below 3 km. ICCs belong to the top 5% reflectivity population at 3 km altitude. Regional differences in the vertical structure of convective cells have been explored for two periods, namely, JJAS (June, July, August and September) and JFM (January, February and March) months. Frequency of occurrences of CbTs and ICCs depend on the region. Africa and Latin America are the most productive regions for the CbTs while the foothills of Western Himalaya contain the most intense profiles. Among the oceanic areas, the Bay of Bengal has the strongest vertical profile, whereas Atlantic Ocean has the weakest profile during JJAS. During JFM months, maritime continent has the strongest vertical profile whereas western equatorial Indian Ocean has the weakest. Monsoon clouds lie between the continental and oceanic cases. The maximum heights of 30 and 40 dBZ reflectivities (denoted by MH30 and MH40, respectively) are also studied. MH40 shows a single mode and peaks around 5.5 km during both JJAS and JFM months. MH30 shows two modes, around 5 km and between 8 km and 10 km, respectively. It is also shown that certain conclusions such as the area/region with the most intense convective cells, depend of the reference height used in defining a convective cell.

1-43 NOAA/STAR S-NPP CrIS Full Spectral Resolution SDR Processing
Authors: Xiaozhen Xiong, Yong Han, Yong Chen, Likun Wang, Denis Tremblay, Xin Jin & Lihang Zhou

The Cross-track Infrared Sounder (CrIS) on Suomi National Polar-orbiting Partnership Satellite (S-NPP) is a Fourier transform spectrometer for atmospheric sounding. CrIS provide measurements in 1305 channels in its normal mode from its launch on November 2011 until the switch to the full spectral resolution (FSR) mode on December 4, 2014. While the NOAA operational Sensor Data Record (SDR) processing (IDPS) continues to produce the normal resolution SDRs as before, NOAA/STAR started to process the FSR SDR data since December 4, 2014 using an algorithm developed on

basis of CrIS Algorithm Development Library (ADL), and provided the data to the public at NOAA/NESDIS/STAR website (ftp://ftp2.star.nesdis.noaa.gov/smcd/xxiong/) with a latency of 12 hours. In the FSR SDR data, the spectral resolutions in both the MWIR (1210-1750 cm-1) and SWIR bands (2155-2550 cm-1) are increased to 0.625 cm-1 as in the LWIR band (650-1095 cm-1), thus providing measurements in 2211 channels. One major benefit to use the FSR data is to improve the retrieval of atmospheric trace gases, such as CH_4, CO and CO_2 which are listed in the level-1 requirements in J-1. This presentation will describe this processing system and the FSR SDR products.

1-44 Applications of GOES data in Brazil
Author: Nelson J. Ferreira

Since early eighties INPE is receiving geostationary satellite data such GOES-8, 10, 11, 12 and currently from GOES-13. The Center for Weather Forecasting and Climate Studies (CPTEC) works in continuous operation of several reception systems and meteorological and environmental satellites information. This activity involves the processing, storage and dissemination of satellite data.

Currently, GOES-13 has been successfully used in Brazil providing imagery data every 30 minutes in routine mode and every 3 hours in RSO mode. This routine reception enabled to improve weather forecasts, disaster management, drought, fires warnings and to monitor extreme weather events. Also training material on the use of GOES over South America designed to increase the forecasters' skill in incorporating satellite data in the short-range forecast, nowcasting, and warning decision makers processes.

Regarding satellite data processing the main products derived from GOES images are:

The atmospheric wind product which is estimated based on satellite images provided by GOES channels, Infrared and Water Vapor to determine the wind (vector) in fully automatic mode. The used methodology is based on the advanced version of the algorithm developed by the European Space Operations Centre. Monitoring Fires, this product generate a map showing the fires detected in all images received from satellites over the past two days over Brazil. Outbreaks of burning are indicated and the data is updated daily. To monitor forest fires a fire detection technique using GOES satellite data was developed at INPE using VIS, NIR and IR.

Rainfall estimates are based on the improved version of the NESDIS hydroestimator which uses a non-linear power law equation that relates cloud top brightness temperature from IR GOES channel and radar-derived rainfall rate estimates.

Solar and Terrestrial radiation, these products are the basis for the development of methods for operational assessment of solar radiation, sunshine duration and outgoing longwave radiation as well as cloud classification and monitoring.

GOES data has being particularly valuable for Brazil.

Using these data CPTEC is able to derive a number of products based on high spatial and temporal resolution data. The use of GOES data particularly have improved significantly satellite detection of severe weather, atmospheric motion vector, solar radiation, cloud classification, rainfall estimates and fire detection, among other derived products.

1-45 Joint Polar Satellite System (JPSS) Common Ground System (CGS) Multimission Support

Authors: Shawn W. Miller, Kerry D. Grant & Michael Jamilkowski

NOAA and NASA are jointly acquiring the next-generation civilian operational weather and environmental satellite system: the Joint Polar Satellite System (JPSS). JPSS will contribute the afternoon orbit component and ground processing system of the restructured National Polar-orbiting Operational Environmental Satellite System (NPOESS). As such, JPSS will replace the current Polar-orbiting Operational Environmental Satellites (POES) managed by NOAA and the ground processing component of the Polar-orbiting Operational Environmental. The JPSS satellites will carry a suite of sensors designed to collect meteorological, oceanographic, climatological, and solar-geophysical observations of the earth, atmosphere, and space. The ground processing system for JPSS is known as the JPSS Common Ground System (JPSS CGS), and consists of a Command, Control, and Communications Segment (C3S) and an Interface Data Processing Segment (IDPS). Both segments are developed by Raytheon Intelligence, Information and Services (IIS). The C3S currently flies the Suomi National Polar Partnership (S-NPP) satellite and transfers mission data from S-NPP and between the ground facilities. The IDPS processes Suomi NPP satellite data to provide Environmental Data Records (EDRs) to NOAA and DoD processing centers operated by the United States government. When the JPSS-1 satellite is launched in early 2017, the responsibilities of the C3S and the IDPS will be expanded to support both Suomi NPP and JPSS-1.

The JPSS CGS currently provides data processing for Suomi NPP, generating multiple terabytes per day across over two dozen environmental data products -- that workload will be multiplied by two when the JPSS-1 satellite is launched. But the CGS goes well beyond mission management and data processing for the Suomi NPP and JPSS missions. The CGS also provides data routing support to operational centers and missions across the globe.

The multimission capabilities of the CGS facilitate support to an array of missions beside S-NPP and JPSS. The CGS also provides raw data acquisition, routing and processing for GCOM-W1 to support further processing by NOAA. The CGS provides data routing for numerous other missions, systems and organizations,

including USN's Coriolis/Windsat, NASA's Space Communications and Navigation (SCaN) network (including the Earth Observation System or EOS), National Science Foundation's (NSF's) McMurdo Station communications, the DoD's Defense Meteorological Satellite Program (DMSP), and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT's) Meteorological Operational Satellites (Metop). For the satellite systems previously listed, each orbits the Earth 14 times a day, downlinking mission data once or twice per orbit at up to hundreds of megabits per second, to support the generation of tens of terabytes per day across hundreds of environmental data products.

Raytheon and the government have invested a significant amount in Raytheon's suite of mission management, command & control and data processing products and capabilities. The CGS's flexible, multimission capabilities offer significant opportunities for cost reduction and improved information integration across missions. Raytheon has a unique ability to provide complex, highly secure, multi-mission ground systems. As disaggregation, hosted CGS Multi-mission payloads, and other space architecture trades are implemented and new sensors come on line that collect orders of magnitude more data, the importance of a flexible, expandable, virtualized modern ground system architecture increase. The CGS offers that solution support.

- The Command, Control and Communications Segment (C3S) manages the operational mission, including mission planning, satellite command & control, global communications networks, enterprise management, situational awareness, anomaly resolution, system security, and reliable delivery of data to and from central users.

- The Mission Management Center provides accurate, high performance tools that precisely manage CGS supported missions. The Command, Control and Communications Segment tools give crews keen insight, comprehensive operational oversight, detailed mission planning capability, full control of space and ground assets, continuous monitoring and assessment of overall system performance.

- The Interface Data Processing Segment (IDPS) features high speed, symmetric, multi-processing computers that rapidly convert large streams of environmental sensor data at 100 times the legacy data volume, providing numerous Environmental Data Records to the weather Centrals.

- The Environmental Data Records detail cloud coverage, temperature, humidity and ozone distribution, as well as snow cover, vegetation, sea surface temperatures, aerosols, space environment and earth

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radiation budget information. This wealth of information enables numerous users to monitor and predict changes in weather, climate, and ocean conditions.

FULLY OPERATIONAL JPSS CGS CAPABILITIES
The CGS:
- Supports five global ground stations that can receive Suomi NPP and/or JPSS-1 mission data. These ground stations, linked with high-bandwidth commercial fiber, can quickly transport the data to the IDPS for environmental data product generation and delivery.
- Processes and delivers data to the operational users in the United States in less than 80 minutes from the time of collection for JPSS-1.
- Leverages the fiber network for Suomi NPP and JPSS-1 to additionally provide data routing for a wide array of missions on a global scale.

The JPSS CGS is a mature, tested solution for supporting operational weather and storm forecasting for civil, military, and international partners as well as climate research. It features a flexible design that handles order-of-magnitude increases in data over legacy satellite ground systems volumes and meets demanding science accuracy requirements. The Raytheon-built JPSS CGS provides the full JPSS common ground capability, from design and development through operations and sustainment. These features lay the foundation for the future evolution of the CGS to support additional missions.

1-46   Improvements to Ensemble Tropical Rainfall Potential (eTRaP)
Authors: Robert J. Kuligowski, Stan Kidder, Liqun Ma, Robert Glassberg, Clay Davenport, Rachel Hatteberg, Mike Turk, Sheldon Kusselson & Beth Ebert

Tropical Rainfall Potential (TRaP) uses storm track forecasts from operational centers to extrapolate rainfall estimates from satellite sensors into forecasts of rainfall from tropical systems. Forecasts covering the same time period from different sensors and/or different track forecasts are then combined into an ensemble called eTRaP, whose outputs include total rainfall accumulation and the probability of exceeding specific accumulation thresholds for the following 24 hours in 6-h segments. These forecasts are produced operationally at NOAA / NESDIS and disseminated via the Internet to users worldwide. A number of improvements have been made to eTRaP since it became an operational product over five years ago, including removing biases in the probabilities and adding new ensemble members such as the infrared-based Hydro-Estimator and the rainfall climatology persistence (R-CLIPER) forecast product. These improvements and their impacts on the availability and skill of eTRaP will be presented.

1-47   Evaluation of Lightning Detection Networks and Implications for GOES-R GLM

Authors: Scott D. Rudlosky & Douglas Kahn

Many meteorological applications use lightning observations from both ground- and space-based lightning detection systems. These systems detect optical or radiometric emissions from lightning, and their data are growing in importance to scientists and operational weather forecasters. Total lightning observations are useful for both storm warning and public safety applications. As the variety of users expands, it becomes increasingly important to understand the detection capabilities of these networks. This presentation briefly introduces multi-scale lightning observations, and then describes the performance of ground-based lightning detection networks. This study evaluates data from the Global Lightning Dataset 360 (GLD360), World Wide Lightning Location Network (WWLLN), and Earth Networks Total Lightning Network (ENTLN) relative to the Tropical Rainfall Measurement Mission (TRMM) Lightning Imaging Sensor (LIS). Direct flash-by-flash comparisons allow analysis of the relative detection efficiency (i.e., assuming LIS is truth), the location and timing differences between matched flashes, and the characteristics of matched and unmatched flashes. This information will help lightning vendors better characterize their network performance, and will provide operational users with important insights as lightning data use continues to grow. Since these ground- and space-based networks detect lightning differently (i.e., optical emissions versus electromagnetic pulses), the close proximity of matched flashes is important for GOES-R Geostationary Lightning Mapper (GLM) risk reduction activities that seek to blend satellite- and ground-based lightning observations.

1-48   Microwave sounder cloud detection using collocated high resolution imager and its impact on radiance assimilation in tropical cyclone forecast
Authors: Yuling Liu, Yunyue Yu, Zhuo Wang, Dan Tarpley

Tropical cyclones (TCs) accompanied with heavy rainfall and strong wind are high impact weather systems, often causing extensive property damage and even fatalities when landed. Better prediction of TCs can lead to substantial reduction of social and economic damage; there are growing interests in the enhanced satellite data assimilation for improving TC forecasts. Accurate cloud detection is one of the most important factors in satellite data assimilation due to the uncertainties of cloud properties and their impacts on satellite observed radiances. To enhance the accuracy of cloud detection and improve the TC forecasts, AMSU-A measurements are collocated with high spatial resolution cloud products from MODIS. The collocated measurements are assimilated for Hurricane Sandy (2012) and Typhoon Haiyan (2013) forecasts using the Weather Research and Forecasting (WRF) model and the 3DVAR-based Gridpoint Statistical Interpolation (GSI) data assimilation system. Experiments are carried out to determine cloud

fraction and cloud top height thresholds to distinguish between cloud affected and cloud unaffected AMSU-A FOVs. The results indicate that the use of the high spatial resolution cloud products from MODIS can improve the accuracy of hurricane forecasts by eliminating cloud contaminated AMSU-A pixels. The methodology used in this study can be applicable to advanced microwave sounders such as ATMS and high spatial resolution imagers such as VIIRS onboard NPP and JPSS series, for the improved TC track and intensity forecasts.

1-49 A Systematic Approach to Building and Maintaining NOAA's Climate Data Records (CDRs)

Authors: Daniel Wunder, C. Hutchins, X. Zhao & W. J. Glance

NOAA established a satellite Climate Data Record Program (CDRP) at its National Center for Environmental Information (NCEI) to provide a systematic process flow to generate sustained and authoritative climate information from satellite data. The CDRP implements a unique approach in archiving not only the data products themselves, but also the software, ancillary data, and documentation which allow full transparency into how the CDR was created. CDRP guidelines align to production guidelines from Global Climate Observing System (GCOS) and WMO's Sustained, Coordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM) activity. Best practices, such as common maturity assessments, guidelines, and standards, are employed to facilitate both the transition of research algorithms to operational software, and the long-term maintenance of the software. The sustained production of multi-decadal inter-calibrated satellite CDRs feed directly into climate applications and tools for ease of use across a broad community of users.

1-50 Adding a Mission to the Joint Polar Satellite System (JPSS) Common Ground System (CGS)

Authors: Shawn W. Miller, Kerry D. Grant, & Michael L. Jamilkowski

The National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) are jointly acquiring the next-generation civilian weather and environmental satellite system: the Joint Polar Satellite System (JPSS). The Joint Polar Satellite System will replace the afternoon orbit component and ground processing system of the current Polar-orbiting Operational Environmental Satellites (POES) managed by NOAA. The JPSS satellites will carry a suite of sensors designed to collect meteorological, oceanographic, climatological and geophysical observations of the Earth.

The ground processing system for JPSS is known as the JPSS Common Ground System (JPSS CGS).

Developed and maintained by Raytheon Intelligence, Information and Services (IIS), the CGS is a multi-mission enterprise system serving NOAA, NASA and their national and international partners. The CGS provides a wide range of support to a number of missions:
1) Command and control and mission management for the Suomi National Polar-orbiting Partnership (S-NPP) mission today, expanding this support to the JPSS-1 satellite and the Polar Free Flyer mission in 2017
2) Data acquisition via a Polar Receptor Network (PRN) for S-NPP, the Japan Aerospace Exploration Agency's (JAXA) Global Change Observation Mission – Water (GCOM-W1), POES, and the Defense Meteorological Satellite Program (DMSP) and Coriolis/WindSat for the Department of Defense (DoD)
3) Data routing over a global fiber Wide Area Network (WAN) for S-NPP, JPSS-1, Polar Free Flyer, GCOM-W1, POES, DMSP, Coriolis/WindSat, the NASA Space Communications and Navigation (SCaN, which includes several Earth Observing System [EOS] missions), MetOp for the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), and the National Science Foundation (NSF)
4) Environmental data processing and distribution for S-NPP, GCOM-W1 and JPSS-1

With this established infrastructure and existing suite of missions, the CGS is extensible to a wider array of potential new missions. This paper will describe the basic steps for adding a mission to the CGS, addressing the existing types of support defined above.

1-51 Level-2 Products in the CSPP-GEO Direct Broadcast Package

Authors: Geoff Cureton, Scott Mindock, Graeme Martin & Liam Gumley

The Cooperative Institute for Meteorological Satellite Studies (CIMSS) has a long history of supporting the Direct Broadcast (DB) community for various sensors, recently with the International MODIS/AIRS Processing Package (IMAPP) for the NASA EOS polar orbiters Terra and Aqua, and the Community Satellite Processing Package (CSPP) for the NOAA polar orbiter Suomi-NPP. CSPP has been significant in encouraging the early usage of Suomi-NPP data by US and international weather agencies, and it is hoped that a new package, CSPP-GEO, will similarly encourage usage of DB data from GOES-R, Himawari, and other geostationary satellites.

One of the capabilities of CSPP-GEO will be to generate Level-2 data products from Level-1 data, using operational algorithms present in the CIMSS geostationary processing framework, GEOCAT. GEOCAT is wrapped in a layer of scripting which serves to handle the various input preparation, ancillary data ingest and user interface handling tasks which lend themselves to a rapid-development scripting approach.

In this work we describe the architecture of the CSPP-GEO Level-2 package, list the supported algorithms, and show examples of various Level-2 outputs generated using the package.

1-52 Soumi NPP CrIS Radiometric Calibration Stability Assessment: A Perspective from Two Years' Inter-Comparison with AIRS and IASI

Likun Wang, Yong Han, Xin Jin, Yong Chen, Denis Tremblay, Xiaozheng Xiao & Mitch Goldberg

The Cross-track Infrared Sounder (CrIS) on the Suomi National Polar-orbiting Partnership (SNPP) and future Joint Polar Satellite System (JPSS) is a Fourier transform spectrometer that provides soundings of the atmosphere over 3 wavelength ranges: LWIR (9.14 - 15.38 µm); MWIR (5.71 - 8.26 µm); and SWIR (3.92 - 4.64 µm). Since it was launched on 29 October 2011, extensive post-launch calibration and validation activities have been carried out by CrIS sensor data record team (SDR), leading to the validated level maturity level of CrIS SDR product in February 2014. In this presentation, the CrIS SDR CrIS radiometric calibration accuracy and its stability are assessed by inter-comparing two-years' CrIS SDR with the radiances from the Atmospheric Infrared Sounder (AIRS) on NASA Aqua and Infrared Atmospheric Sounding Interferometer (IASI) on Metop-A and –B. First, the CrIS radiance measurements on SNPP are directly compared with IASI on MetOp-A and -B at the finest spectral scale through the simultaneous nadir overpass (SNO) observations at the Polar Regions. Moreover, CrIS radiances are compared with AIRS on Aqua in 25 selected spectral regions through the SNO observations in both Polar and Tropical regions. The spectra from different sounders are paired together through strict spatial and temporal collocation. The uniform scenes are selected by examining the collocated Visible Infrared Imaging Radiometer Suite (VIIRS) pixels. Their brightness temperature (BT) differences are then calculated by converting the spectra onto common spectral grids. The time series and scene-dependent feature of BT differences are examined. On the other hand, CrIS was switched into the full spectral resolution mode since 4 December 2014. While the official CrIS SDR product was still processed and released as the normal resolution by Interface Data Processing Segment (IDPS), the NOAA/STAR CrIS SDR team off-line processed and released CrIS FSR SDR products. The intercomparion of CrIS FSR SDR products with AIRS and IASI is also covered in this presentation.

1-53 Characteristics of Detected Salt Storms by AVHRR Sensor on Noaa Satellites From 2006 to 2014 in Argentina

Authors: Diana Rodriguez, Silvana Carina Bolzi & Inés Velasco

Salt storms only happen in places where there are large deposits of salt on the ground, like those around the Aral Sea in Central Asia, the Great Salt Lake in the United States of America and in the Mar Chiquita Lake in Argentina. These storms are low clouds whose development is similar to dust storms, except for the characteristics of the soil where they originate. The extent of the water surface of the Mar Chiquita Lake has experienced increases and decreases over the years. However, since 2003 the Lake began a period of regression, exposing large areas of land covered with salt. Since 2006, observations from space with different satellites allowed to document the presence of very white salt clouds originated when fine sediments around the lake perimeter are easily lofted into the air by winds. The occurrence of salt storms near the Mar Chiquita Lake from 2006 to 2014 is documented using satellite images captured by sensor AVHRR on NOAA 17, 18 and 19 satellites and downloaded by the receiving station at the Argentina´s Meteorological Service. In addition to the images, the corresponding records of weather conditions that complement the basis of spectral data were archived, allowing face future interdisciplinary studies. A simple visual analysis of the images reveal that these storms have occurred with varying degrees of development, from a weak plume to a thick cloud of great extent. These forms of expression are linked to hydrological and meteorological factors. Probably for these reasons, a variation is also observed in the number of cases per year and also during the year. Most storms recorded occurred during the winter months, with winds almost exclusively south or north, but more with southerly winds. The salt event on 29 July 2012 was investigated with two reflective and two infrared thermal AVHRR bands. It is found that salt clouds are more reflective than the background soil, but less reflective than water or ice clouds, probably because salt clouds have less optical thickness. Other characteristics of these clouds are that the observed 11µm minus 12µm brightness temperature difference (BTD) is always negative. Then it could be used for the identification of salt storm outbreak and for the estimation of the spatial extent developed. Also, it can be used in both daytime and night time conditions for automatic salt storm identification.

1-54 Impact of the satellite-derived inner core data on HWRF hurricane intensity forecasts

Authors: Qingfu Liu, Banglin Zhang, Xiaolin Xu, Fuzhong Weng & Vijay Tallapragada

HWRF model is the operational hurricane track and intensity forecast model at NCEP. The HWRF model initial field is a combination of the vortex initialization and data assimilation. To improve the initial hurricane structures, airborne radar data has been added to the hurricane initialization in 2013. However, the data collections are expensive and only about 10% of the cases have airborne radar data. In order to improve all hurricane inner core structures, we are working to add

the satellite-derived inner core data (temperature/water vapour fields) to HWRF hurricane initialization. Preliminary results show that there is a potential that the hurricane intensity forecasts can be significantly improved in HWRF model.

1-55 The impact of the high temporal resolution GOES/GOES-R moisture information on severe weather systems in regional NWP model

Authors: Pei Wang, Jun Li, Yong-Keun Lee, Zhenglong Li, Jinlong Li, Zhiquan Liu, Tim Schmit & Steve Ackerman

The quality of a humidity analysis directly impacts severe storm analysis and forecasts. With high temporal and spatial resolution, GOES-R's humidity information can improve regional/storm scale data assimilation. The Advanced Baseline Imager (ABI) (Schmit et al. 2005) from GOES-R will provide atmospheric water vapor with three water vapor absorption spectral bands during both day and night, which is very important for improving the initialization of regional/storm scale numerical weather prediction (NWP) models. However, utilization of high temporal resolution moisture information in NWP remains challenge. In order to enhance the use of GOES-R water vapor regional and storm scale NWP, the current GOES Sounder data are used as proxy for investigating the assimilation of high temporal resolution moisture information in the regional NWP model. Both radiances and precipitable water (PW) products at three sigma level values (0.3-0.7, 0.7-0.9, and 0.9-1) are assimilated and compared. The Weather Research and Forecasting (WRF) with 4 km resolution is used in the forecast experiments while the DTC-GSI 3D-var is used as assimilation system, the layer PW (LPW) products from GOES-13/-15 Sounder are retrieved using the GOES-R legacy atmospheric profile (LAP) algorithm and a forward operator is developed and integrated into GSI for assimilating LPW . Focuses are on how to better assimilate the high temporal moisture information, including cycling assimilation scheme, bias adjustment, observation error setting, use of information in cloudy region, radiance assimilation versus retrieval assimilation, etc. To verify the impacts of assimilating GOES layer PW, the forecasted accumulated precipitation, radar reflectivity, and temperature and moisture profiles are compared with the observations. The 24 hour, 6 hour and 1 hour accumulated precipitation from forecasts are verified against the NCEP Stage IV analysis precipitation. The temperature and moisture profiles are verified with the radiosondes profiles. Both the frequency bias and the equitable threat score (ETS) are computed to show the impacts of LPW on CONUS storm precipitation forecasts.

1-56 NOAA/NESDIS Sounding Data Products from the Next Generation Of Satellites

Author: Awdhesh Sharma

Vertical and horizontal distributions of atmospheric temperature, water vapor, clouds, and chemical composition are essential climate observations. High spectral resolution infrared sounding has made significant improvements in retrievals from the Cross-track Infrared Sounder (CrIS) and the Advanced Technology Microwave Sounder (ATMS) instruments on board the Suomi-National Polar-orbiting Partnership (S-NPP) and the Infrared Atmospheric Sounding Interferometer (IASI), residing on the European Space Agency's (ESA) MetOp series of polar orbiting satellites. In a series of advanced operational sounders CrIS in conjunction with ATMS provides more accurate, detailed atmospheric temperature and moisture observations for weather and climate applications. Higher (spatial, temporal and spectral) resolution and more accurate sounding data from CrIS and ATMS support continuing advances in data assimilation systems and NWP models to improve short- to medium-range weather forecasts. Currently the IASI level 2 products from Metop satellites include temperature and humidity profiles, trace gases such as ozone, nitrous oxide, carbon dioxide, and methane, and the cloud cleared radiances (CCR) on a global scale and these products are available to the operational user community.

In an effort to ensure consistent levels of service and quality assurance for the CrIS/ATMS data the NOAA Unique CrIS/ATMS Product System (NUCAPS) data products, the Office of Satellite and Product Operations (OSPO) has implemented and executing new, innovative tools to better monitor performance and quality of the operational sounder and imager products that are being generated. The incorporation of these tools in the OSPO operation has facilitated the diagnosis and resolution of problems when detected in the operational environment. This poster presentation will include several of these tools developed and deployed for the sounding products monitoring and data quality assurance which lead to improve the maintenance and sustainment of the Environmental Satellites Processing Center (ESPC) processing systems. The presentation will include the discussion on the ESPC system architecture involving sounding data processing and distribution for CrIS, IASI, and GOES sounding products. Discussion will also include the improvements made for data quality measurements, granule processing and distribution, and user timeliness requirements envisioned from the next generation of JPSS and GOES-R satellites. There have been significant changes in the operational system due to system upgrades, algorithm updates, and value added data products and services.

1-57 Precipitation Validation to support NOAA operational Products

Authors: J.J. Wang, S. D. Rudlosky & R. R. Ferraro

The Cooperative Institute for Climate and Satellites – Maryland (CICS-MD) hosts a precipitation calibration and validation center which conducts both daily and

seasonal validation of STAR rainfall products over the contiguous United States. Daily rainfall amounts are validated relative to rain gauge data, and radar data are used to validate composites of swath products over the U.S. Seasonal validation is performed for several NESDIS-generated operational rainfall products (i.e., SCaMPR, MiRS, MSPPS, and the HydroEstimator), which were originally developed by STAR scientists. For comparison, validation also was extended to CMORPH, Merged Microwave, GPI (CPC), TRMM (NASA), NRL Blended, PERSIANN (UC Irvine), and GSMAP (JAXA). This research effort seeks to provide algorithm developers with feedback on the performance of their products, which will help guide decisions on whether to divert resources toward algorithm improvement or to investigate reasons for recent algorithm behavior (good or poor). The website used for disseminating results has undergone a complete transformation to ease access and better serve the community. The main page now directly links our various validation activities, and archives now provide access to daily imagery over 60 days old. Navigation buttons also accompany the daily validation images, allowing for easier analysis of consecutive days. Seasonal rainfall validation for the ongoing 2014-2015 seasons is routinely conducted and the new results are posted within one month after each season. The CICS-MD precipitation Cal/Val efforts are expanding to incorporate several exciting new rainfall estimates, including the JPSS GCOM AMSR-2, ATMS MiRS, NESDIS bRR, Environmental Data Records (EDR) rain rate from SSMI/S, and the products from the newly launched GPM. These Cal/Val activities also will help ensure that the operational algorithms from GOES and JPSS meet long-term performance requirements.

1-58   Extending the long-term data records of SO2 and NO2 with the SNPP OMPS Nadir Mapper
Authors: Kai Yang, Simon A. Carn, Cui Ge & Jun Wang

We describe recent advances in retrieval techniques that improve the measurements of tropospheric NO2 and SO2 from space. We apply these new techniques to the observations of OMPS Nadir Mapper, flying on the Suomi NPP spacecraft since October 2011. The results demonstrate the unexpected capabilities of OMPS, which are enabled by the algorithmic advances. OMPS is providing sensitive measurements of air pollutants over the globe, with sensitivities similar to those achieved with Aura/OMI. The NO2 and SO2 data from SNPP/OMPS have sufficient quality to continue and extend NASA's long-term EOS NO2 and SO2 data records, and can be used to monitor daily air pollution and identify anthropogenic sources of NO2 and SO2.

1-59   Using hyper-spectral sounding products to improve short-range forecasts in the Alaska Region
Authors: Ralph A. Petersen, Lee Cronce, William Line & Robert Aune

In previous meetings, we have described development and forecaster evaluations of the CIMSS NearCasting system. Tests of 1-9 hour forecasts using Geostationary Earth Orbiting (GEO) GOES and SEVIRI (as a surrogate for GOES-R) products made at several National Weather Service Centers and the European Severe Storms Laboratory (ESSL) have focused both on where/when all types of deep convection will/will not occur and which convection will likely become severe. Results showed that NearCasts: 1) improve conventional satellite observation displays; 2) enhance NWP guidance; 3) provide information about low-level triggering mechanisms and storm severity, but; 4) require increased forecaster training and education - both of the system and the satellite observations/products that drive it.

During the past several years, forecasters in the high-latitude Alaska Region (AR), where GEO data are not available, have requested that the NearCasting techniques be applied using hyper-spectral sounder products generated from the multiple Low Earth Orbiting (LEO) satellites that make frequent overpasses there. Separately, feedback from ESSL has pointed to the need for more information about vertical moisture and stability structures, such as will be available from the hyper-spectral Infra-Red Sounder (IRS) to be included in METEOSAT Third Generation (MTG).

This presentation demonstrates the potential of new short-range forecaster tools designed to use otherwise underutilized hyperspectral soundings in AR. Although these observations lack the special and temporal detail of GEO data, the increased vertical sounding resolution should be especially important both in areas with limited radar coverage or other asynoptic observations and when conventional NWP guidance is questioned. The methodology is applied using multiple operational LEO satellites (CrIS, IASI and AIRS). Case studies of hazardous weather events will be used to compare the impact of higher-time-frequency GEO data to the less-frequently-updated hyper-spectral LEO observations over northern Europe where both GOES-R-like GEO and hyperspectral LEO data are available.

A wide range of forecasters have also noted the additional need for short-range guidance using full resolution satellite observations in cloudy conditions (not included in IR-only satellite products) are needed for a variety of problems, especially those related to heavy precipitation events and oceanic weather systems. To address this need, NearCasts generated using combined IR/microwave retrievals are also presented to illustrate how these LEO data can add short-range forecast information in areas where IR instruments are 'blind'. These observationally driven short-range projections could be important could provide a unique LEO/GEO synergy by filling spatial gaps in future high-time frequency GOES-R IR products and displays.

1-60　Infrared and Microwave Data Addition Observing System Experiment Impacts using the NCEP Global Forecast System

Authors: James A. Jung & Mitch Goldberg

Observing System Experiments (OSEs) are used to quantify the contributions to forecast skill by various types of sensors or observing systems. They help to highlight the impact of some of the numerous data sources available today. The purpose of this study is to investigate the overall impact of the major infrared and microwave sensors used by the National Centers for Environmental Prediction's (NCEP) Global Forecast System (GFS).

The design of these experiments will consist of a two week spin-up period followed by a month long assimilation-forecast cycle during two extreme seasons (January and August). The experiments will start from a baseline of conventional and the Global Positioning System – Radio Occultation (GPS-RO) data. From this baseline, the individual sensors (AIRS, IASI, CrIS, AMSU, ATMS, and SSMIS) will be added. The forecasts from these experiments will be verified against a control which uses nearly all of NCEP's operational data. The forecast skill will then be compared to the control, the baseline as well as the individual sensors.

2-1 Assessment of J1 VIIRS Polarization Sensitivity Impacts on Sensor Data Records

Authors: Wenhui Wang, Changyong Cao & Aaron Pearlman

Prelaunch polarization characterization indicates that the polarization sensitivity in bands M1-M4 of the Visible and Infrared Imaging Radiometer Suite (VIIRS) onboard the Joint Polar Satellite System–1 (JPSS-1, J1) is higher than the performance specifications. It is important to understand its impacts on the sensor data records (SDR) for reliable environment data records (EDR) retrieval, such as ocean color products. This study focuses on assessments of the impacts of J1 VIIRS polarization sensitivity on band M1 (0.411μm) in which the degree of linear polarization (DoLP) due to Rayleigh scattering and instrument polarization sensitivity are more profound than other bands.

In this study, Suomi NPP VIIRS band M1 polarization components for the Rayleigh scattering were modeled using the Second Simulation of a Satellite Signal in the Solar Spectrum Vector Code, version 1.1 (6SV) . Polarization characteristics as functions of solar illumination and sensor view geometry were first studied. Then we adopts a MODIS polarization correction method proposed by Meister et al. (2005) to investigate the impact of linear polarization on J1 VIIRS band M1 TOA reflectance. J1 VIIRS was assumed to have the same along track and along scan patterns and local equator crossing time as that of the NPP VIIRS. Clear-sky Stokes vectors for the Rayleigh component were simulated using 6SV for a representative NPP VIIRS orbit over the Pacific Ocean. J1 VIIRS prelaunch polarization sensitivity data, including polarization amplitude and phase angle for each band, HAM-side, detector, and scan angle, were obtained from the NASA VIIRS Calibration Support Team. Our results indicates that J1 VIIRS polarization sensitivity can cause: (1) as much as ~4% of errors in band M1 SDR (compared to a ideal instrument without polarization sensitivity); (2) as much as ~4% of striping in band M1 SDR due to differences in detector level polarization amplitude and phase angle.

2-2 Exporting VIIRS and MODIS Products for Visualization using Polar2Grid

Authors: Daniel Tong, Li Pan, Lok Lamsal, Pius Lee, Youhua Tang, Hyuncheol Kim, Min Huang, Ivanka Stajner, Lawrence Flynn, Shobha Kondragunta & Kenneth Pickering

Accurately quantifying nitrogen oxides (NOx = NO + NO2) emissions, which are precursors to the formation of ground-level ozone (O3) and fine particulate matter (PM2.5), in a timely manner is essential for improving NOAA national air quality forecasting guidance. These emissions have been changing and the time lag due to the preparation of emission inventory updates means that inventory-based emissions are always based on several-years-old information, potentially affecting the accuracy of National Air Quality Forecast Capability (NAQFC) O3 and PM2.5 predictions. This study proposes a new approach that utilizes the trend data derived from satellite and ground observations to reduce the time lag of updating anthropogenic NOx emission inventories over the continental United States. Multi-year NOx trends are derived from the Ozone Monitoring Instrument (OMI) and the Air Quality System (AQS) observations following the procedures in Tong et al. (2015). A simple weighting function is used to fuse the trend data into a combined projection factor, which is then used to adjust NOx emission data from the national emission inventories. The adjusted emission data are tested with the NAQFC modeling system, and the results are compared to the current operational system and against observations. The comparisons show that the new emission data assimilation approach can outperform the current operational forecast system in terms of all statistical metrics, including mean bias, normalized mean bias, root mean square error, and correlation. This study demonstrates the feasibility of assimilating satellite and ground observations for timely updates of emission data to improve operational ozone forecast skills.

2-3 Direct Broadcast and Stored Mission Data Behavior in Relation to CrIS Full Spectrum

Authors: Kevin Gross & Sean Lyons

The Suomi NPP CrIS (Cross-track Infrared Sounder) instrument provides atmospheric soundings of temperature, moisture, and pressure for accurate and detailed weather modeling. Historically, CrIS downlinked different length interferograms based on the spectral band and while the entire interferogram was downlinked for Long-wave Infrared (LWIR), onboard truncation was performed on the Medium-wave Infrared (MWIR) and Short-wave Infrared (SWIR) interferograms. Thus, a proposal for an operational change to the instrument configuration was accepted to enable full length interferograms of all three spectral bands. CrIS Full Spectrum Mode was previously tested using various methods, but resulted in data loss due to a shared buffer between the Direct Broadcast Data stream and Stored Mission Data (SMD) stream. Additional methods to enable CrIS full spectrum were ultimately ruled as unsustainable for long term use. However, extensive testing determined that to prevent buffer overflow, data reallocation to the Direct Broadcast Data stream was required for CrIS to remain in Full Spectrum Mode permanently. These changes were performed by removing several data packets from the Direct Broadcast Data flow and set them to come down in SMD data only. Engineers continue to monitor the effects of CrIS Full Spectrum on the Direct Broadcast Data and Stored Mission Data behavior. The data analysis presented will

encompass the observations and behavior in Direct Broadcast Data and Stored Mission Data as it relates to CrIS Full Spectrum. To date, as a result of the changes made, the increased CrIS data sent to the Direct Broadcast Data stream has not caused an overflow and the CrIS instrument is capable of remaining in Full Spectrum Mode.

2-4 Value-added Impact of Geostationary Hyperspectral Infrared Sounder on Storm forecasts – A quick regional OSSE demonstration

Authors: Zhenglong Li, Jun Li, Feng Zhu, Pei Wang, Timothy Schmit, Agnes Lim, Robert Atlas & Ross Hoffman

The Suomi NPP satellite launched in October 2011 is a bridge mission between the NOAA POES and NASA EOS mission, and the future Joint Polar Satellite System (JPSS). The Visible Infrared Imager-Radiometer Suite (VIIRS) sensor onboard S-NPP and JPSS builds upon the heritage of AVHRR and MODIS sensors, flown onboard NOAA/MetOp and Terra/Aqua satellites, respectively. Global sea surface temperature (SST) products at native resolution of VIIRS IR bands have been generated operationally since January 2012 by the Interface Data Processing Segment (IDPS) system, developed by the Raytheon, and experimentally by the Advanced Clear-Sky Processor for Oceans (ACSPO) system, developed at STAR. The support and maintenance of the IDPS SST product has been also transferred to STAR in 2011. The ACSPO system, in addition to VIIRS data, also generates operational SSTs from several AVHRRs (NOAA 16-19, and MetOp-A &- B) and experimental SSTs from two MODISs, onboard Terra and Aqua. With a range of SST products available from different systems, a required and desirable step in the SST community is validation and cross-comparison of these products to check for their relative merits, in a timely manner. The SST Quality Monitor (SQUAM), developed at STAR, monitors most major global SSTs from polar-orbiters generated at different agencies and reports their performance and comparisons statistics online at www.star.nesdis.noaa.gov/sod/sst/squam. The SQUAM methodology is based on statistical analyses of differences in retrieved SST (TS) with respect to several reference SST fields (TR), including global L4 fields and in situ SST data. One year of VIIRS SST observations from IDPS and ACSPO in SQUAM will be presented in this poster. Performances of VIIRS SST algorithms and cloud-masks, from both ACSPO and IDPS systems, will be shown and cross-comparison of VIIRS products with those from AVHRR and MODIS discussed.

2-5 Evaluation of the VIIRS Risk Reduction Aerosol Optical Thickness Algorithm

Authors: Hongqing Liu & Istvan Laszlo

Under the JPSS Risk Reduction (RR) project, an Aerosol Optical Thickness (AOT) retrieval algorithm is developed at NOAA/NESDIS based on the experience from

evaluation of the operational VIIRS algorithm and development of the GOES-R ABI algorithm. Compared with the operational VIIRS algorithm the RR AOT algorithm has : (1) more stringent internal tests for detecting unfavorable retrieval conditions, (2) extended the spatial coverage (includes bright land surface and inland lake) and measurement range (from -0.05 to 5.0) of retrieved AOT, (3) updated aerosol models that account for the non-spherical shape of dust and are consistent with the ones used in the MODIS algorithm, (4) scene dependent land surface spectral reflectance relationship. The RR AOT algorithm can also be used with GOES-R ABI data to achieve a cross-platform consistency of NOAA satellite-based aerosol retrievals. As a proof of concept, the RR AOT algorithm is run with VIIRS data over an extended time period to evaluate its performance against the AERONET measurements, current operational VIIRS retrievals, and latest MODIS Collection 6 aerosol products. Preliminary results show increased spatial coverage, capturing high AOTs during exceptional events, and improved performance.

2-6 A near real time satellite data assimilation system at CIMSS for research and applications on using JPSS and GOES-R

Authors: Jun Li, Jinlong Li, Pei Wang, Hyojin Han & Tim Schmit

JPSS and GOES-R observations play important role in numerical weather prediction (NWP). However, how to best represent the information from satellite observations and how to get value added information from these satellite data into regional NWP models, including both radiance and derived products, still need investigations. In order to enhance the applications of JPSS and GOES-R data in regional NWP for high impact weather (HIW) forecasts, scientists from Cooperative Institute of Meteorological Satellite Studies (CIMSS) at University of Wisconsin-Madison have recently developed a near realtime regional Satellite Data Assimilation system for Tropical storm forecasts (SDAT) (http://cimss.ssec.wisc.edu/sdat). The system consists of the community Gridpoint Statistical Interpolation (GSI) assimilation system and the advanced Weather Research Forecast (WRF) model. In addition to assimilate GOES, AMSUA/AMSUB, HIRS, MHS, ATMS (Suomi-NPP), AIRS and IASI radiances, the SDAT is also able to assimilate satellite-derived products such as hyperspectral IR retrieved temperature and moisture profiles, total precipitable water (TPW), GOES Sounder (and future GOES-R) layer precipitable water (LPW) and GOES Imager atmospheric motion vector (AMV) products into the system. On one hand, SDAT can serve as research testbed for improving the assimilation of satellite data (JPSS and GOES-R) in regional NWP (e.g., handling clouds, using high temporal and spatial resolution WV information, etc.); on the other hand, SDAT forecast products have been provided in near real time (NRT) since October 2014 to ATCF (automatic tropical cyclone forecasts) system that users can access

for applications. In addition, research progress on satellite data assimilation made with SDAT has the potential of transition to operational NWP models.

2-7 Verifying NWP model analyses and forecasts using simulated satellite imagery
Authors: Thomas Blackmore, Roger Saunders & Simon Keogh

Simulated satellite imagery is a way of interpreting numerical weather prediction (NWP) model output by presenting it as if it were a satellite image. The imagery is created using a fast radiative transfer model, RTTOV-11, to calculate a top of atmosphere brightness temperature or reflectance from NWP model surface parameters and profiles of pressure, temperature, humidity and cloud properties from every NWP model grid-point. When the simulated values are plotted as an image this can be compared with observed satellite imagery.

Currently simulated imagery is produced for a number of geostationary imagers, including those on Meteosat and GOES-E from the Met Office Global NWP model. Water vapour, IR window and visible channels can all be simulated. Simulated imagery can also be produced for convective scale models and ensemble members. Examples will be shown.

These images are generated in real time and are used by forecasters at the Met Office. They can be compared to real satellite images to quickly verify the model analyses and short range forecasts or where real imagery is not yet available to provide a forecast satellite image to help interpret what the weather situation will be. They help to give the forecasters more or less confidence in the model predictions. They can also be used by research scientists to determine how an upgrade to the model which alters the cloud and moisture fields compares with a control model run and the real satellite images. This can provide useful guidance as to whether the proposed change has improved the model fields to match the satellite image more closely.

2-8

2-9 Vicarious validation of straylight correction for VIIRS Day/Night Band using Dome-C
Authors: Shi Qiu, Xi Shao, Changyong Cao & Wenhui Wa

The Day/Night Band (DNB) of the Visible Infrared Imaging Radiometer Suite (VIIRS) onboard Suomi National Polar-orbiting Partnership (Suomi-NPP) represents a major advancement in night time imaging capabilities. The VIIRS DNB sensor is affected by stray light. Straylight effect on the DNB instrument is due to solar illumination entering the optical path after the satellite passes through the day-night terminator projected on Earth's surface. It results in an overall

increase in the recorded radiance values. This effect is more significant during solstice. After launch of Suomi-NPP in October 2011 there is a gray haze in radiance images observed by DNB due to straylight and straylight correction has been implemented to remove this effect. This study performs vicarious validation of straylight correction for VIIRS DNB band using Dome-C in Antarctic. Nadir observations of these high latitude regions by VIIRS are selected during perpetual night season, i.e. from April to July during the year 2014 under various lunar phases. The lunar spectral irradiance model, as a function of Sun-Earth-Moon distances and lunar phase, is used to determine the top-of atmosphere (TOA) reflectance at the vicarious site. The comparison of observed radiance and model predictions for different lunar phases are shown in this paper. In addition, the cross-comparison between DNB observations for events with/without straylight is also demonstrated. The VIIRS DNB data from two sources such as IDPS and NASA Land Peate are compared, which revealed some differences possibly due to difference in the calibration algorithm implementation.

2-10 GOES-R AWG Collocation Project Status
Authors: Greg Quinn, Bob Holz, Fred Nagle & Ralph Kuehn

The GOES-R collocation project leverages decades of experience in applying vector algebra and analytic geometry to problems in satellite navigation and remote sensing collocation at CIMSS. The tools and techniques underlying the collocation project originated in the 1970s as part of the NOAA satellite group lead by Bill Smith and Fred Nagle to help support the early NOAA polar and geostationary instruments. The GOES-R AWG project has provided the support to greatly expand these tools to support AWG calibration and validation efforts, enabling months or years of data to quickly be collocated and compared for statistical analysis or long term monitoring.

This poster presents an overview of the collocation project and highlights recent work. Current focus includes validation and monitoring of data from Himawari-8, including inter-calibration of AHI using CrIS and VIIRS aboard Suomi NPP. A web-based visualization and monitoring system has been developed and is being enhanced to streamline exploration of collocated products. And AWG collaboration efforts continue, including a 2006-2013 comparison of GOES wind retrieval heights using CALIPSO, enhancements to the collocation project toolset to facilitate volcanic ash validation, and continued processing and validation support for AWG cloud products.

2-11 Facilitation of OMPS Dark Table Production Transition to GRAVITE by STAR Algorithm Integration Team (AIT)
Authors: Bigyani Das, Weizhong Chen, Kristina Sprietzer & Walter Wolf

The Center for Satellite Applications and Research (STAR) Algorithm Integration Team (AIT) was tasked to facilitate the Ozone Mapping and Profiler Suite (OMPS) Dark Table production transition process from the OMPS Product Evaluation and Analysis Tool Element (PEATE), at NASA Goddard Space Flight Center, to NOAA's Government Resources for Algorithm Verification, Independent Test and Evaluation (GRAVITE) facility. In this work we will present the process we have used to create OMPS Dark tables for OMPS Nadir Profiler (NP) and OMPS Nadir Mapper (NM) within STAR. Currently the Dark tables are produced at OMPS PEATE through a series of algorithms that are termed as Algorithm Plugin Package (APP). We use these APPs from PEATE to create Dark tables on the STAR linux machines. The complete process includes four main sub-processes; 1) Creating L1A files from Raw Data Record (RDR) files, 2) Using those L1A files to produce Sensor Data Record (SDR) files, 3) Using SDR files to create Dark files in HDF5 format and then 4) using these HDF5 files to produce the final binary files. The binary files are directly used operationally within NOAA's Interface Data Processing Segment (IDPS) facility. These Dark files are integrated into IDPS every week since the OMPS Sunday orbits are used to produce the Dark files.

We have used the above four processes to create Dark files successfully and have communicated the information with both input and output to the GRAVITE system staff members for verification. The GRAVITE staff has tested and verified our results. We have written Perl scripts to tie all the above four processes together to create the Dark tables using the RDR files and the other required input. The requirements, the libraries, the four processes and the Perl scripts will be discussed.

2-12   Suomi NPP VIIRS Imagery Update
Authors: Don Hillger, Curtis Seaman, Steven Miller, Thomas Kopp, Ryan Williams & Gary Mineart

The VIIRS EDR imagery Team continues to be involved in both the checkout of Suomi NPP VIIRS Imagery, as well as preparations for the use of VIIRS from JPSS-1 and 2. VIIRS EDR Imagery attainted the Validation 3 maturity stage in 2014, which means that most of the major Imagery issues have been resolved, but the Team's work continues. There is currently more emphasis on the expectations for VIIRS imagery from JPSS-1 in particular. For example, a recent request was made for possible impacts upon VIIRS Imagery related to a lowering of the noise performance in certain JPSS-1 thermal bands.

The Imagery Team continues to press for 2 major improvements that they consider critical to more widespread use of VIIRS Imagery. The first and foremost is a vital reduction in the latency of global VIIRS Imagery, which now may be 6 or 7 hours old by the time it's available for the Imagery Team. Data access is also occasionally slow due to heavy demand for VIIRS by many users. Direct Broadcast (DB) VIIRS partly alleviate this issue, but the DB is only available from selected locations and not globally. The other major issue is that not all the M-bands are currently turned into EDR Imagery, the advantage of which addresses two issues: both the intentional bowtie deletions and remaining overlapping pixels in VIIRS SDR Imagery.

The latter issue is being worked through the appropriate channels by not only firming up the VIIRS EDR Imagery requirements that will be applied to JPSS, but by seeking to add all the M-bands to those requirements. The existing VIIRS requirement documents, which were inherited from the NPOESS world, need to be reworked for JPSS now that SNPP Imagery is available and is a useful guide for JPSS.

Finally, the Imagery Team continues to support other EDR Teams and other users in their applications of the VIIRS Imagery in the analysis and forecast world. Part of that support is a comprehensive VIIRS EDR Imagery Users' Guide that is being prepared as a future NOAA Technical Report (TR), to accompany the NOAA TR produced by the VIIRS SDR Team.

2-13   Investigating and monitoring the hurricane inner core structure with retrieved temperatures from NPP ATMS
Authors: Banglin Zhang, Qingfu Liu, Vijay Tallapragada & Fuzhong Weng

While the skill of tracking tropical cyclones has been significantly improved during the past decades, it remains a very challenging area of research to accurately predict the life cycle of tropical cyclones, particularly their initial formation, intensity change, and the final dissipation. The challenge comes partially from the lack of knowledge on hurricane structures, especially when the hurricane circulations are weak and diffuse over open oceans where few upper-air observations are available from ships, commercial and reconnaissance aircrafts. With satellite observations, a more accurate hurricane vortex structure from surface to the upper-level atmosphere may be produced.

At NOAA/NCEP/EMC, a quasi-operational package was developed for online monitoring of the hurricane inner core structure by using NPP ATMS bufr data as input to retrieve the temperature fields from surface up to 1hPa on flying. Tropical storm structure and intensity from the ATMS retrieved temperature anomalies showed some cases HWRF over predicted storm intensity when HWRF initial warm core was stronger than ATMS retrieved warm core, and in some other cases HWRF under predicted storm intensity when HWRF initial warm core was weaker than ATMS derived warm core. This provided us the base to use the vortex structure from ATMS to correct the vortex structure in the hurricane

inner core region so the intensity forecasts of hurricanes could be improved.

2-14 Modeling Suomi-NPP VIIRS Solar Diffuser Degradation due to Space Radiation

Authors: Xi Shao & Changyong Cao

The Visible Infrared Imaging Radiometer Suite (VIIRS) onboard Suomi-NPP uses a solar diffuser (SD) as on-board radiometric calibrator for the reflective solar band (RSB) calibration. Solar diffuser is made of Spectralon (one type of fluoropolymer) and was chosen because of its controlled reflectance in the VIS-NIR-SWIR region and its near-Lambertian reflectance profile. Spectralon is known to degrade in reflectance at the blue end of the spectrum due to exposure to space radiations such as solar UV radiation and energetic protons. These space radiations can modify the Spectralon surface through breaking C–C and C-F bonds and scissioning or cross linking the polymer, which causes the surface roughness and degrades its reflectance. VIIRS uses a SDSM (Solar Diffuser Stability Monitor) to monitor the change in the Solar Diffuser reflectance in the 0.4 – 0.94 um wavelength range and provide a correction to the calibration constants. The H factor derived from SDSM reveals that reflectance of 0.4 to 0.6um channels of VIIRS degrades faster than the reflectance of longer wavelength RSB channels. A model is developed to derive characteristic parameters such as mean SD surface roughness height and autocovariance length of SD surface roughness from the long term spectral degradation of SD reflectance as monitored by SDSM. These two parameters are trended to assess development of surface roughness of the SD over the operation period of VIIRS.

2-15 Latest developments related to the improvement of the operational NOAA VIIRS active fire product

Authors: Ivan Csiszar, Louis Giglio, Wilfrid Schroeder & Evan Ellicott

The current NOAA operational active fire product from the Visible Infrared Imaging Radiometer Suite (VIIRS) on the Suomi National Polar-orbiting Partnership (NPP) satellite is based on 750m M-band measurements and delivers a list of pixels flagged as "fire" by the detection algorithm. This product is generated operationally within the Interface Data Processing Segment (IDPS). An improved product that also delivers a full spatially explicit fire mask and fire radiative power (FRP) over the entire globe has been implemented into NOAA operations. Product development is carried out in the framework of NOAA and NASA programs and though close interaction with the upstream VIIRS Sensor Data Record (SDR) Science Team, with the Direct Readout data provider and user community, and with developers of key operational applications that use VIIRS fire data as input. In this presentation critical issues related to input and output data quality, long-term monitoring, and further algorithm development efforts will be discussed to

ensure the delivery of a high-quality data product to the end users.

2-16

2-17 Towards Improving our Understanding on the Retrievals of Key Bio-physical Parameters from Space: the work done within the PREMIER-EO Project

Authors: Prashant K. Srivastava, George P. Petropoulos, Gareth Ireland, Matthew R. North & Crona Huges

Acquiring accurate information on the spatio-temporal variability of soil moisture content (SM) and evapotranspiration (ET) is of key importance to extend our understanding of the Earth system's physical processes, and is also required in a wide range of multi-disciplinary research studies and applications. The utility and applicability of Earth Observation (EO) technology provides an economically feasible solution to derive continuous spatio-temporal estimates of key parameters characterising land surface interactions, including ET as well as SM. Such information is of key value to practitioners, decision makers and scientists alike.
The PREMIER-EO project recently funded by High Performance Computing Wales (HPCW), U.K. is a research initiative directed towards the development of a better understanding of EO technology's present ability to derive operational estimations of surface fluxes and SM. Moreover, the project aims at addressing knowledge gaps related to the operational estimation of such parameters, and thus contribute towards current ongoing global efforts towards enhancing the accuracy of those products.
In this presentation we introduce the PREMIER-EO project, providing a detailed overview of the research aims and objectives for the 1 year duration of the project's implementation. Subsequently, we make available the initial results of the work carried out herein, in particular, related to an all-inclusive and robust evaluation of the accuracy of existing operational products of ET and SM from different ecosystems globally.
The research outcomes of this project, once completed, will provide an important contribution towards addressing the knowledge gaps related to the operational estimation of ET and SM. This project results will also support efforts ongoing globally towards the operational development of related products using technologically advanced EO instruments which were launched recently or planned be launched in the next 1-2 years.

2-18 Neural Network Technique for Gap-Filling of Satellite Ocean Color Observations for use in Numerical Modeling

Authors: Sudhir Nadiga, Vladimir Krasnopolsky, Avichal Mehra, Eric Bayler & David Behringer

An important goal of NOAA is an operational global coupled physical ocean-biogeochemical model that

employs a scientifically consistent and robust methodology to link biological processes and upper ocean dynamics, assimilating ocean color observations to initialize and constrain model evolution. Integrating/assimilating satellite ocean color fields (chlorophyll-a, Kd490, KdPAR) into NOAA's operational ocean models requires robust techniques to address potential gaps in the observations. This analysis of a Neural Network (NN) gap-filling technique examines linking ocean color variability, primarily driven by biological processes, with the physical processes of the upper ocean. This study employs satellite-derived surface variables – sea-surface temperature (SST), sea-surface height (SSH) and sea-surface salinity (SSS) fields – as signatures of upper-ocean dynamics. Using this NN method to correlate satellite ocean color fields with other assimilated satellite observations has the advantages of: a) instigating fewer assimilation errors, and b) not relying on sparse in situ ocean color observations. Neural networks are very generic, accurate, and convenient mathematical models that emulate complicated nonlinear input/output relationships through statistical learning algorithms. Neural provide robustness with respect to random noise and fault-tolerance neural network only needs to be done once for a particular application. This study employs ocean color fields from the Visible Imaging Infrared Radiometer Suite (VIIRS) and the SSS fields from the Aquarius mission, while the SSH and SST fields are from multiple sources via NOAA. The satellite observations used in this study are well documented and available, or soon to be available, in near-real time. All satellite data (2012-2014) were interpolated to the same one-degree latitude-longitude grid and are available at daily temporal resolution. The correlations between the ocean color data and the SSH/SST/SSS fields are spatially and temporally dependent. Results are validated by evaluating the time series of the various fields for selected boxes in deep-ocean and coastal environments. By rotating the time series, the NN technique is trained for two years and tested on the remaining year for each year of data. The adequacy of the results is assessed by examining the root-mean-square difference (RMSD) between the observed ocean color fields and the NN output.

2-19 Integrating Changes to VIIRS Vegetation Index Algorithm using Algorithm Development Library (ADL)

Authors: Qiang Zhao, Biganyi Das, Weizhong Chen, Marina Tsidulko, Valerie Mikles & Walter Wolf

The Joint Polar Satellite System (JPSS) is the next generation polar-orbiting operational environmental satellite system. The first in the JPSS series of satellites, J-1, is scheduled to launch in early 2017. To comply with the JPSS-1 requirements, an additional product, the Top-of-Canopy (TOC) Normalized Difference Vegetation Index (NDVI), has been developed and integrated into the Visible Infrared Imaging Radiometer Suite (VIIRS) Vegetation Index (VI) algorithm suite at NOAA/STAR. The enhanced algorithm was extensively tested within both the offline algorithm development tool, the Algorithm Development Library (ADL), and the operational builds (MX8.4, MX8.5 and the current version MX8.6) through a series of algorithm chain runs for two days of VIIRS data. Comparison studies were conducted to evaluate the impacts of upstream aerosol algorithms changes on the VI products. The output data files were provided to the VI Science Team to perform the final validation of the algorithm. The testing and integration process as well as the product validation steps shall be discussed.

2-20 Automated JPSS Products Processing of the Algorithm Development Library (ADL) by using Chain Run Scripts

Authors: Weizhong Chen, Bigyani Das, Kristina Sprietzer, Valerie Mikles, Marina Tsidulko, Yunhui Zhao, Qiang Zhao, Vipuli Dharmawardane & Walter Wolf

The Joint Polar Satellite System (JPSS) is the next generation polar-orbiting operational environmental satellite system. The first satellite in the JPSS series of satellites, J-1, is scheduled to launch in early 2017. J1 will carry similar versions of the instruments that are on board of Suomi National Polar-Orbiting Partnership (S-NPP) satellite which was launched on October 28, 2011. To run S-NPP and pre-J1 algorithms in a development and test mode, the center for Satellite Applications and Research (STAR) Algorithm Integration Team uses the Algorithm Development Library (ADL). The ADL is an offline test system developed by Raytheon to mimic the operational system while enabling a development environment for plug and play algorithms. The STAR Algorithm Integration Team (AIT) has developed a Perl Chain Run Script to automate the staging and processing of multiple JPSS Sensor Data Record (SDR) and Environmental Data Record (EDR) products. The script has been used to provide test data for verification of algorithm and Look-Up-Table (LUT) changes related to various SDR and EDR products. In this poster, we will discuss the structure of the Chain Run Script and its use. We will use VIIRS Cloud Mask, Aerosol, Surface Reflectance and Vegetation Index as examples to show how to use this script to process JPSS data.

2-21 Accurate Data Flow Management Tool Facilitates Operational Stability and Risk Management in a Complex and Dynamic Science Processing Environment

Authors: Laura Ellen Dafoe & Jeffrey Hayden

The Joint Polar Satellite System (JPSS) Interface Data Processing Segment (IDPS) produces dozens of meteorological data products useful to weather and climatology scientists. The processing chain to result in these products is complex, with interdependency among the products themselves as well as with databases

external to the JPSS system. Data flow management through this system presents a challenge with multiple sources and users of various data products. The data flow has been modeled using MagicDraw, an Enterprise Architecture application using DODAF formalism. The MagicDraw modeling tool allows different views or perspectives of the same system while maintaining a unified construct. The model is very accurate since it is built from the Algorithm Development Library code itself, rather than from requirements documents or software descriptions. The data flows are generated from the configuration files, and the process and data element names are the operational names. Collection Short Names are included in the data elements. The JPSS Program uses the model to manage responsibilities for products, to create and manage requirements specifications, and to scope downstream impacts to changes in a particular product. With the upcoming transition to a distributed science processing paradigm, this model could be extended to model the full data processing flow in IDPS, NPP Data Exploitation (NDE), and GOES-R. Managing the data flow between and within these systems will be challenging without a similar tool.

A top level view of the IDPS science data processing system and several examples of different views are provided, along with a demonstration of how the model is derived from the ADL examples.

2-22   Real-time Monitoring Land Surface Vegetation Phenology from VIIRS Observations

Authors: Xiaoyang Zhang, Lingling Liu & Yunyue Yu

Vegetation phenology investigates the timing and magnitude of vegetation progress over the land surface. Satellite observations provide a unique opportunity to monitor vegetation phenological development and properties at regional and global scales. While vegetation phenology has been widely determined from the time series of historical satellite data throughout the last decade, real-time monitoring and short term forecasting are currently very challenging. However, the latter is particularly important for numerical weather modeling, ecosystem forecasting, forest and crop management, and health risk warning. In this study we developed an innovative approach to monitor and forecast spring green vegetation growth and autumn color foliage status (including low coloration, moderate coloration, near-peak coloration, peak coloration, and post-peak coloration) using timely available JPSS VIIRS observations. Specifically, we detected and removed the cloud and snow contaminated VIIRS vegetation indices (VI) in the available time series by employing VIIRS land surface temperature (LST) and snow cover products. On the other hand, we established phenology climatology and variance from MODIS observations from 2001-2012 for the determination of possible phenological

development beyond current observations. By combining the climatology of vegetation phenology and timely available time series of VIIRS VI, we generated a set of potential temporal trajectories of vegetation development at a given time and pixel. These trajectories were used to identify spring and autumn vegetation phenology development in real time, to predict the occurrence of future phenological events, and, furthermore, to analyze the uncertainty of monitoring and forecasting. Based on this approach, we established a system to produce the monitoring and forecasting of vegetation phenology development from JPSS VIIRS every three day.

2-23   The development of the GOES Early Fire Detection (GOES-EFD) system to reduce disaster vulnerability in America

Authors: Alexander Koltunov, Brad Quayle, Susan Ustin, Elaine Prins, Vince Ambrosia & Carlos Ramirez

Although geostationary satellites have been successfully monitoring active fires for decades, the corresponding wildfire products have not significantly contributed to reducing wildfire latency before the initial identification, which could lead one to a conclusion that GOES with its large pixel footprint, is not suitable for early warning. However, the capabilities of satellites and sensors are not the only determining factors for detecting ignitions – algorithms are also essential. The NOAA operational wildfire algorithm, WF-ABBA, was designed and optimized for users and applications for which timeliness of initial detection is a lower priority, contrasting to the needs of first responders for reliable early detection.

We present our progress in developing the GOES Early Fire Detection (GOES-EFD) system, a collaborative effort led by University of California-Davis and USDA Forest Service. The GOES-EFD specifically focuses on first detection timeliness for wildfire incidents. It utilizes all three dimensions of the GOES images sequences: spectral, spatial, and most importantly, temporal dimension.

Using GOES-11 and GOES-15 as examples, we demonstrate that the current GOES-EFD prototype can detect new ignitions significantly earlier than existing operational capabilities and further improvements are within reach. These additional minutes spared by GOES-EFD often lead to the earliest alarm and thus could help land management agencies reduce the risk of an ignition evolving into a catastrophic wildfire, such as the 2013 California Rim fire. Early detections can also be routinely used for rapid confirmation of initial fire ignition reports from conventional sources. In either case, upon deployment the GOES-EFD products can improve strategic and tactical decision making by fire managers, help increase public safety, and minimize impacts on natural resources and property. The intermediate level outputs, such as cloud mask and estimated background radiance, could improve operational retrieval of FRP and

other fire properties by WF-ABBA, especially during the initial stages of burning.

Additionally, this science to operations effort also looks forward to the improved capabilities of the upcoming GOES-R mission. This will present a great opportunity for GOES-EFD to maximize the NOAA GOES program contribution to disaster reduction in America.

2-24

2-25 Evaluate and constrain modeled ozone and its source contributions in the US using satellite trace gas observations
Authors: Min Huang, Kevin Bowman, Greg Carmichael, Meemong Lee, Dejian Fu, Tianfeng Chai, Daniel Tong, Pius Lee & Youhua Tang

Near-surface ozone (O3) concentrations in the western US are sensitive to non-local and local sources. As US O3 primary standard may be designated below current 75 ppbv in Oct 2015, accurately modeling O3 and its source contributions has gained increasing policy-relevant significance. In this study, we first explored the potential of using single and multi-spectral satellite trace gas observations to evaluate and constrain US O3 source contributions estimated by a multi-scale data assimilation system composed of the global GEOS-Chem model and the regional STEM model. Focusing on California-Nevada during NASA ARCTAS field campaign period in summer 2008, we demonstrated that STEM-predicted O3 fields and the non-local and local source contributions to the surface O3 concentrations were improved via sequentially assimilating O3 profiles from Tropospheric Emission Spectrometer (TES) and tropospheric nitrogen dioxide (NO2) columns from Ozone Monitoring Instrument (OMI) (Huang et al., 2014). The observation-constrained regional O3 prediction was then broadly compared against rich in-situ observations as well as the newly developed OMI+AIRS multi-spectral O3 retrievals that show improved sensitivity to O3 in the troposphere (Fu et al., 2015). Further, discussions were extended to the directions of integrating JPSS data for evaluating and constraining predicted O3 during recent years in the NOAA National Weather Service National Air Quality Forecast Capability (NAQFC) system, which recently successfully incorporated OMI NO2 columns to rapidly update National Emission Inventory and improve O3 prediction in the continental US (Tong et al., 2015).

2-26 VIIRS Boats, Lights, Fires and Flares
Authors: Chris Elvidge, Kimberly Baugh, Feng-Chi Hsu, Mikhail Zhizhin, Tilottama Ghosh

The NCEI Earth Observation Group (EOG) specializes in the development of nighttime VIIRS data products for boats, lights, fires and flares. This focus traces back to DMSP, which had a low light imaging capability similar to VIIRS. In 2012 EOG developed the VIIRS Nightfire (VNF) product, which uses fire detections in bands

M7,8,10,12 & 13 to model combusion source Planck curves. VNF is currently the only global fire product providing temperate and source size estimates. EOG produces nightly global DNB mosaics and monthly cloud-free DNB composites. In 2014 EOG developed a VIIRS boat dectection (VBD) system, which is currently running for Indonesia.

2-27 Development of the Visible Detector Assembly for the Flexible Combined Imager on MTG
Authors: James Endicott, J. Pratlong, A. Pike, W. Hubbard, P. Jerram, A. Walker & D. Davies

e2v has been involved in many Solar Physics and Solar Weather satellites, Hinode (Solar-B), SETERO, SDO, IRIS and SUVI both in Europe and across the pond! We have also supplied many of Europe's Earth monitoring weather and atmospheric satellites such as Envisat, Sentinel-2, 3 and now 4 and 5. We have supplied detectors into OMI for NASA's Aura satellite and OMPS for NPOESS.

Here we report our development of the Visible Detector Assembly for the Flexible Combined Imager on Meteosat Third Generation, MTG FCI VisDA. e2v has successfully passed the Preliminary Design Review for the detector and has demonstrated in silicon that the detector is latch-up free up to the maximum energy of our test facility, 67.7MeV/mg/cm^2.

2-28 Impact of AMSU Derived Hydrological Products on Merged Precipitation Products
Authors: Thomas M. Smith, Ralph R. Ferraro, Huan Meng & Wenze Yang

Satellite precipitation estimates are used to complement surface reports obtained from radars and rain gauges. However, in regions where no surface reports exist or are limited, satellites remain the sole source of precipitation information. Over the past decade, blended precipitation products have emerged and have demonstrated their importance in providing global precipitation estimates. The most successful products combine satellite microwave and IR measurements and anchor them with high quality rain gauges (where they exist). Of utmost importance is obtaining adequate sampling of the diurnal cycle of precipitation. Although individual techniques have their own know level of accuracy, the so-called "sampling" error dominates when deriving global, daily (or longer) precipitation products.

In this poster, the impact of AMSU precipitation estimates on a merged estimate is evaluated using products from multiple satellites. The region containing the continental US (25°N-60°N by 125°W-65°W) is chosen so that adequate surface observations are available to document the impact. Data from NOAA 15, NOAA 16, NOAA 17, NOAA 18, NOAA-19 and MetOP-A are binned onto a daily 1° grid for several months during the data rich period between 2005 and 2010. Evaluations are performed using individual satellite

estimates, merged combinations of satellite estimates, and all satellite estimates merged, for both daily and monthly averages. Comparisons are made against the AMSU estimate using all satellite estimates and against GPCP daily estimates. Comparisons to GPCP are best when all satellites are used, although the average increase in spatial correlation is least when going from 4 to 5 satellites. The importance of more satellites is clearest in the daily comparisons, when skipping one or more satellites may cause an individual precipitation event to be under sampled. For monthly averages individual events are averaged out and fewer satellites are needed to adequately sample the region.

2-29 Developing VIIRS Ocean Color Products for Coral Reef Ecosystem Managers

Authors: Alan E. Strong, Menghua Wang, C. Mark Eakin, Eric Geiger, William Hernandez, & Maria Cardona

NOAA Coral Reef Watch (CRW) and NESDIS/STAR's Ocean Color Team are developing new satellite products from the Visible Infrared Imaging Radiometer Suite (VIIRS) on the Suomi National Polar-orbiting Partnership (SNPP) that assist in monitoring the threat of land-based sources of pollution (LBSP) to coral reef ecosystems. NOAA has identified LBSP as one of the major threats to coral reefs that can cause coral disease and mortality, disrupt critical ecological functions, and impede growth, reproduction, and larval settlement. Following two years of in-house prototype work (FY13/14), a new collaboration between STAR and NOAA's Coral Reef Conservation Program is building ocean color tools that managers can use to track water quality on or near their reefs, to assist with the timely and effective management of local pollution from watershed alteration, run-off, and coastal development. Near-real-time satellite products of turbidity [Diffuse Attenuation Coefficient at 490 nm-Kd(490)], Chlorophyll-a, and SST are being developed for the three U.S. Coral Reef Task Force Priority Watershed sites - Ka'anapali (West Maui, Hawai'i), Faga'alu (American Samoa), and Guánica Bay (Puerto Rico). Background levels of each parameter are being derived using VIIRS data from which we can construct anomaly products. Starting with the earliest-available VIIRS data (2012), time-series products for each watershed will be developed giving managers information as to how water quality conditions have varied through time. The project team also plans to incorporate in-situ measurements over coral reefs to validate each parameter, in collaboration with NOAA Educational Partnership Program (EPP) doctoral candidate interns. A pilot calibration/validation field study of the VIIRS-based ocean color products for coral reefs is already underway in Puerto Rico (Guánica Bay Watershed – La Parguera) with the University of Puerto Rico's Bio-Optical Oceanography Laboratory. Subject to the outcome of this pilot effort, proposals will be submitted to expand the Cal/Val work with NOAA EPP to include the priority watersheds in Hawai'i and American

Samoa. NOAA CRW will also continue to engage local coral reef managers to ensure the new regional ocean color products are relevant and useful.

2-30 A Prototype Precipitation Retrieval Algorithm for Advanced Technology Microwave Sounder (ATMS)

Authors: Yalei You, Nai-Yu Wang & Ralph Ferraro

A prototype precipitation retrieval algorithm over land has been developed utilizing a 3-yr Multiple Radar Multi-Sensor Precipitation Estimation (MRMS) and the Advanced Technology Microwave Sounder (ATMS) coincident datasets. The Linear Discriminant Analysis method and Bayesian framework are employed to detect and retrieve precipitation. One of the unique features of this algorithm is using the ancillary parameters (i.e., surface type, surface temperature, land elevation and ice layer thickness) to stratify the single database into many smaller but more homogeneous databases, in which both the surface condition and precipitation vertical structure are similar. In addition, the different scanning angles have also been taken into consideration when the databases are constructed in the Bayesian framework. It is found that the probability of detection (POD) is 82.3% and 71.6% for rainfall and snowfall, respectively. The correlation and root-mean-square-error between retrieved and observed rainrates are 0.63 and 1.80, while it is 0.45 and 0.72 for snowfall. More importantly, the error (variance) is also computed for each pixel and the one-standard deviation well covers the precipitation dynamical range. Additionally, it is demonstrated the retrieved precipitation clearly capture the geo-spatial distribution of precipitation features.

2-31 Survey of OSPO Efforts to Improve Operational GOES Imagery

Authors: S. Hadesty, K. Ludlum, N. Sanders & C. Thomas

This presentation discusses efforts of the OSPO GOES Image Navigation and Registration (INR) and Scheduling teams to sustain and improve delivery of image data products. Examples resulting in a direct positive impact are chosen for description.

The cases are organized within two categories: those which increase image data volume through minimization of non-imaging activities and those which improve the geometric calibration of image data. Specific cases illustrating the former category include: development of a process to execute periodic station-keeping maneuvers during daily house-keeping periods and minimize cancelled imagery, implementation of optimized schedules and improved INR predictions to execute routine image sequences during special operations periods; applied image duration analysis to reduce payload idle time between image frames. Examples of the latter are: response to an instrument degradation anomaly that resulted in corrupt navigation

measurements; temporary loss of fine spacecraft attitude pointing due to a hardware anomaly resulting in degraded image navigation.

These cases show the value of on-orbit operations experience and how it can be leveraged to benefit the user community.

2-32 Production of Satellite Land Surface temperature dataset at STAR

Authors: Yunyue Yu, Yuling Liu, Peng Yu, Yuhan Rao & Ivan Csiszar

Information on land surface temperature (LST) is critical on understanding climate change, modeling the hydrological and biogeochemical cycles, and is one of prime candidate parameters for numerical weather prediction assimilation models. Satellite remote sensing is the only resource for providing regular regional and global LST measurements. The satellite LST production has been conducted over 30 years, through a variety of sensors onboard geostationary- and polar-orbiting satellites; a number of different algorithms have been applied for LST derivation from those sensor datasets. The LST team at center for SaTellite Applications and Research (STAR), NOAA NESDIS, is responsible for developing/improving and validating the LST products for the current JPSS and the future GOES-R satellite missions, as well as for the current Geostationary LST measurements from GOES-13 and GOES-15 Imagers. In this poster presentation we provide details on our activities and accomplishments along with the above satellite missions. Also, we desire to obtain feedbacks from NOAA LST user community.

2-33 Quality Assessment of Suomi NPP VIIRS Land Surface Temperature Product

Authors: Yuling Liu, Yunyue Yu, Peng Yu & Zhuo Wang

The Visible Infrared Imaging Radiometer Suite (VIIRS) onboard the Suomi NPP satellite (S-NPP) provides Land Surface Temperature (LST) Environmental Data Records (EDRs) with a spatial resolution of 750m at nadir. The LST EDR is derived from a split-window regression algorithm and the algorithm coefficients are surface type dependent as refer to 17 International Geosphere-Biosphere Programme (IGBP) types. VIIRS LST has gone through the maturity evolving process, reaching validated one maturity in December 2014, during which problems in the software package and in the LUT have been corrected. This study compares the most recent VIIRS LST product, generated with a newly implemented LUT since April 7, 2014 , with the ground in-situ observations in SURFace Radiation Budget Network (SURFRAD) and Africa, and with heritage LST product from Moderate Resolution Imaging Spectroradiometer (MODIS) Aqua collection 5. The result presents a generally good agreement. Comparisons against SUFRAD observations indicate an overall accuracy of -0.37K and precision of 2.35 K with a

better accuracy achieved at nighttime compared to that at daytime. The result over arid regions in Africa suggests that both VIIRS and MODIS underestimate the LST by 1.6K and 3K, respectively. Some issues are observed: (1) Cloud contamination, particularly the cloud detection over snow/ice surface, show great impacts on LST validation quality. (2) VIIRS LST performance is strongly dependent on a correct classification of the surface type. The uncertainty analysis indicates that the given surface type commission error causes 0.7K LST error using MODTRAN simulation data and 1.2K LST error using the real data. (3) VIIRS LST is degraded under the conditions featured with high BT difference between split windows, which is attributed to the overcorrection of atmospheric effect using the quadratic term of BT difference in the retrieval algorithm. (4) Surface type dependent algorithm exhibits inefficiency in overcoming the large emissivity variations within a surface type. A possible algorithm refinement is proposed for further improvement.

2-34

2-35 Addressing User Demands: Enhancing NOAA Coral Reef Watch's Satellite Decision Support System for Coral Reef Managers

Authors: Erick F. Geiger, C. Mark Eakin, Gang Liu, Jacqueline L. De La Cour, Scott F. Heron, William J. Skirving, Alan E. Strong

NOAA Coral Reef Watch (CRW) has been providing coral reef ecosystem managers and other stakeholders with near-real-time global satellite-based sea surface temperature (SST) products at 50-km resolution since 1997. These heritage products have helped users worldwide understand and predict the development of mass coral bleaching events. Over the last few years, the number one request from users has been for higher-resolution products at or near reef scales to better monitor their coral reef environments. Recent work at NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) has resulted in an operational Geostationary (Geo)-Polar Blended SST Analysis product that provides daily global gap-filled 5-km resolution data. CRW has been using these data to produce next-generation coral bleaching thermal stress products at substantially improved spatial and temporal resolutions. The new 5-km coral bleaching products use a newly developed SST climatology derived from the Pathfinder SST climate data record. The 2014 bleaching season has shown that the 5-km products and climatology are improvements over the heritage 50-km products. Managers in Florida, Hawaii, and many other parts of the globe have applied them to their monitoring and management practices.

Recognizing that temperatures can vary across reefs at sub-km scales, CRW is striving to push monitoring products to a 1-km scale for test regions in the Coral Triangle and Australia's Great Barrier Reef. Sub-km scale VIIRS-only SST data have been tested for CRW's

applications as well and validated using new coastal in situ observations as part of an ongoing JPSS Proving Ground and Risk Reduction-funded effort. However, STAR's 5-km Blended SST analysis has demonstrated that the addition of high-frequency geostationary observations is needed to ensure the reliability of a daily SST analysis, especially in regions with persistent cloud cover. We hope next to combine sub-km VIIRS SSTs and 2-km Himawari-8 and GOES-R SSTs to develop regional1-km blended products. These analyses will allow CRW to meet the ever-growing needs of managers and scientists for accurate and timely information on stresses to coral reefs in the face of climate change and warming ocean waters.

2-36 Updates on the NESDIS Operational Blended TPW Products

Authors: Limin Zhao, Stanley Kidder, Sheldon Kusselson, John Forsythe, Andrew Jones , Ralph Ferraro, Clay Davenport, Vicky Lin & Stephen Quinn

The blended TPW products system merges individual Total Precipitable Water (TPW) products derived operationally from NOAA and DMSP low-earth-orbiting polar satellites and also from the Global Positioning System (GPS) and the GOES Sounders over the CONUS to provide unified TPW and Percentage of TPW Normal products over the globe. These products have been supported 24x7 at the NESDIS Environmental Satellite Processing Center (ESPC) since 2009 and made operationally available to the NOAA and private user communities. The operational availability of the blended TPW products provides timely assistance to forecasters and satellite analysts in assessing the evolution and transport of moisture, and also in predicting precipitation, especially extreme heavy precipitation events that result in flooding. The imagery products can also be accessed through http://www.ospo.noaa.gov/Products/bTPW. The web-based animation loop provides users a tool for tracking atmospheric rivers/moisture plumes over a specified time period for particular regions and has been found to play a central role in modulating extreme rainfall events. This presentation will provide updates on recent enhancements and future plans in the forthcoming years for the operational generation, monitoring and distribution of the blended TPW products. A couple of case studies showing the application of the blended TPW products for hazardous weather conditions will also be presented. This presentation will provide updates on recent enhancements and future plans in the forthcoming years for the operational generation, monitoring and distribution of the blended TPW products. A couple of case studies showing the application of the blended TPW products for hazardous weather conditions will also be presented.

2-37 GOES-R GRB direct readout at NWS National Centers

Authors: Harlan Yates, Liz Nielsen & Allan Weiner

In March 2016, NOAA will launch the first of the new generation of GOES satellites. GOES-R satellites will provide significantly improved imaging resolution and more timely updates to the weather community. As a result, the current GOES VARiable (GVAR) service will be replaced with the new-generation GOES-R Rebroadcast (GRB) system. The GRB signal's high bandwidth direct satellite reception will be a highly effective, lowest-latency, and highest-reliability solution for most users. Harris Corporation's WxConnectTM – GRB offers a modular and scalable access and product-generation solution that provides high availability and secure reception of enhanced environmental satellite data from the GOES-R satellite system in near real time. Harris Corporation's WxConnectTM – GRB is the primary source of direct readout GRB data for the NWS National Centers, and the NWS Alaska and Pacific Regional Centers. A full complement of GOES-R sensors including the ABI, GLM and Space Weather instruments will provide data to the mission critical AWIPS II systems at these centers. This poster will describe the WxConnectTM – GRB data access solution and the benefits this direct source of data brings to the NWS National Centers.

2-38 Comparison of Atmospheric Rivers depicted from satellite and NWP reanalysis

Authors: Wenze Yang & Ralph Ferarro

Atmospheric River (AR) is a recent hot topic in meteorological/atmospheric/hydrological research mostly due to its central role in the global water cycle as they "are responsible for > 90% of all atmospheric water vapor transport in mid-latitudes", and being identified as the major contributor for the extreme precipitation hitting west coastal areas of the world, including North America, Europe, and North Africa. Further, ARs can be responsible for heavy rainfall events just about anywhere, as the moisture they transport helps to sustain the precipitation forcing from slow moving weather systems. Despite the characterization of ARs to be crucial as a proxy of extreme events, most of the identification done to support weather forecasting applications is done manually through the use of satellite total precipitable water (TPW) imagery, or automatically but in only one region (west coast U.S.).

We have developed an objective methodology for detecting AR's that can be applied to any global field of TPW. Tests have included application to ERA-Interim and the MiRS TPW fields and have shown its utility in detecting global AR's contributing to recent flooding events across the U.S. and Europe. The importance of such a tool is that a global climatology of AR's can be developed on both satellite and NWP reanalysis data sets to investigate changes in the characteristics over time in the AR's – origin regions, length and duration, land falling regions, etc. Here, we'd like to show the

depicting AR results of our methodology from several atmospheric humidity data sources: from satellite observations as MiRS, or blended TPW, and from NWP reanalysis as ERA, or MERRA.

2-39   Use of Weather Satellite Data for Federal Aviation Administration Operations

Authors: Randall Bass & Steve Abelman

Weather satellite data provide a relevant and important contribution in support of the Federal Aviation Administration mission to provide the safest, most efficient aerospace system in the world. Timely weather satellite data is vital in aviation operations, as well as in research to improve weather support to those operations and to mitigate impacts from hazardous weather conditions. Aviation weather analyses and forecasts, primarily provided by NOAA, support all aspects of flight from planning, takeoff and departure, en route, and through arrival and landing. Both polar and geostationary satellite data and imagery is used to detect phenomena such as thunderstorms and convection, turbulence, icing, cloud ceilings and visibility, space weather, and volcanic activity that adversely impact the National Airspace System. Just as important, satellite imagery is leveraged by aviation meteorologists, air traffic managers, air carriers and general aviation pilots to determine where areas of good weather are for effective routing and safe travel. This data is critical not only for aviation purposes in the United States, including Alaska and Hawaii, but also for offshore areas far into the Atlantic and Pacific Oceans.

This poster shows examples of aviation weather products derived from satellite data, provides an overview of these products, and discusses how those products are used to support Air Traffic Management operational decisions.

2-40   Testing of Emissivity Explicit Retrieval Algorithms for VIIRS Land Surface Temperature

Authors: Peng Yu, Yunyue Yu, Yuling Liu & Zhuo Wang

Land surface temperature (LST) is of fundamental importance to many aspects of the geosciences, e.g., the net radiation budget at the Earth surface and to monitoring the state of crops and vegetation, as well as an important indicator of both the greenhouse effect and the energy flux between the atmosphere and the land. The LST product of the Visible Infrared Imaging Radiometer Suite (VIIRS) onboard the Suomi National Polar-orbiting Partnership (S-NPP) satellite uses a surface type based retrieval algorithm. The large within-type emissivity variability and the uncertainty of surface type data may lead to a large variability in the retrieval accuracy across different or even within the same surface types. A comparison of the VIIRS LST and the SURFRAD in-situ observations for the year of 2013 show RMSEs ranging from 1.61K at the Desert Rock site

to 3.35K at Sioux Falls site. This problem is addressed by the explicit inclusion of the emissivity value into the retrieval algorithm. The algorithms being tested use a few variables, water vapor, day/night condition, and satellite viewing zenith angle, to stratify the retrieval in different situations, allowing more flexibility to fine tune the algorithm. At the boundary between two neighboring retrieval situations, continuity of the retrieval is not satisfied. An interpolation scheme is being tested. The above testing results also apply to the GOES-R ABI algorithm, where VIIRS data is used as a proxy. This study presents the most recent progress towards this goal and some preliminary results obtained from a few case studies.

2-41   GOES-R Impact on NCEP Computing

Authors: James Gundy, Gregg Kowalski, Bradley Brown-Bergtold & Allan Weiner

GOES-R is scheduled to launch in March 2016. It will produce raw data at a rate of 100 Mbps and Level 0/1/2+ data at a rate of 16 TB per day. Level 1b data is processed into useful observations of current conditions for the entire Western Hemisphere. These L1b observations and Level 2+ data are inputs to initialize multiple EMC analysis and forecast models. They will be at temporal and spatial resolutions far greater than what is available today and will require efficient handling of the data within NCEP architecture for analysis and forecast modeling systems.

Harris has designed a High Performance Computing (HPC) environment for NOAA's GOES-R Ground System to ensure all data are available with 5 minute latency and a minimum Operational Availability of 0.9999. The Harris GOES-R Ground System is a Service Oriented Architecture (SOA) composed of services for Enterprise Management, Mission Management, Product Generation, and Product Distribution. Each of these services provides high reliability through redundancy of critical components and functions, ensuring there is no single point of failure in the system. Additionally, Product Generation and Product Distribution services are highly parallelized to achieve the required 5 minute latency. A high throughput, low latency Enterprise Service Bus (ESB) is used for message traffic between services, and a highly reliable, high throughput Data Fabric is used for data transfers between algorithms services. Data communications between all services are provided through a high speed, low latency 10 gigabit Ethernet network.

The GOES-R system is just one of the new generation of observation systems supporting NCEP modeling and forecasting. These systems will produce larger volumes of data, at higher frequencies, with better operational availability than the current observation systems that supply data to the NCEP. In developing GOES-R, multiple HPC and high reliability technologies were merged to build an efficient, fast, and reliable system. This poster will present the features of the GOES-R architecture allowing it to efficiently and reliably produce

data in an HPC environment.

2-42 Monitoring and forecasting Dust Haze over West Africa using satellite imageries and Numerical Weather Prediction output
Authors: Abdou Adam Abdoul-Aziz Abebe, Abdelkrim Ben Mohamed, Ilboudo Goama & Saley Diori

Dust Haze occurrence over the sub-Saharan Africa is an annual phenomena, which has attracted quite a lot of attention from both for forecasters and scientists. Between november and march, observations show that large dust plumes are transported from both the Sahara and Sahel towards West African Countries and accross the Atlantic Ocean.Predicting Dust haze generation should be an Sahara and Sahel towards West African Countries and accross the Atlantic Ocean. Predicting Dust haze generation should be an important application of meteorology to development in this area both for economic and social aspects.The main objective of the present study is todevelop methodologies for better interpretation and use of NWP and Satellite. The main objective of the present study is to develop methodologies for better interpretation and use of NWP and Satellite products in forecasting Dust Haze generated by the predominant mechanism associated with pressure gradient tendency; improve the knowledge and techniques required to exploit potential predictability of Dust Haze;verification of weather forecasts. One should however keep in mind that atmospheric soundings are needed when other generation mechanisms are concerned.

2-43 Suomi NPP VIIRS Reflective Solar Band On-orbit Radiometric Performance Assessment
Authors: Sirish Uprety & Changyong Cao

The Visible Infrared Imaging Radiometer Suite (VIIRS) is a key instrument flying aboard Suomi NPP satellite. It is a follow on mission for NOAA series AVHRR and NASA MODIS. The radiometric stability and accuracy of VIIRS is critical to make its data useful for weather and climate applications. VIIRS on-orbit radiometric performance is regularly monitored and analyzed using well established calibration sites and through the inter-comparison with other satellite instruments such as AQUA MODIS and Landsat 8 OLI. The study shows that VIIRS moderate resolution reflective solar bands are stable with better than 0.5% for most of the bands with uncertainty on the order of 1%. EO-1 Hyperion observations are used to analyze the impact due to instrument spectral differences. Due to the absence of in-situ Hyperion measurements, a large number of observations are used in the analysis in order to reduce the impact due to the variation in atmospheric constituents. After accounting the spectral differences, the absolute radiometric bias

estimated through VIIRS and MODIS inter-calibration is within 2% for bands M1-7 and M10. VIIRS and OLI intercalibration suggested about 5.4% bias for band M11. The most recently updated results on VIIRS calibration stability and accuracy will be presented.

2-44 Improved Ground-Based Polarization Sensitivity Measurement Capability for Next-Generation Environmental Remote Sensing Systems
Authors: Aaron J. Pearlman, Frank Padula, Changyong Cao & Xiangqian Wu

Both the J1 Visible Infrared Imaging Radiometer that will be onboard the Joint Polar Satellite System (JPSS) spacecraft and the Advanced Baseline Imager that will be onboard GOES-R spacecraft showed polarization sensitivity in their pre-launch testing. This sensitivity influences retrievals of aerosol and ocean color products. In order to characterize performance impacts that could arise from polarization sensitivity effects on-orbit, an understanding of polarization phenomenology is necessary. Radiative transfer codes are typically used to evaluate polarization impacts, but further measurements are needed to validate such codes. We are continuing to develop a ground-based spectroradiometer for polarization measurements by combining an off-the-shelf spectroradiometer with an enhanced front-end design to measure varying linear polarization states. This improves our original design by extending the wavelength range and reducing measurement uncertainties. We plan on employing this instrument to support GOES-R and other flight campaigns.

The manuscript contents are solely the opinions of the authors and do not constitute a statement of policy, decision, or position on behalf of NOAA or the U.S. government.

2-45 Evaluation of Near Surface UAV Capabilities for the GOES-R Field Campaign
Authors: Francis Padula, Changyong Cao, Istvan Laszlo, Yunyue Yu & Steve Goodman

The recent technological advance of low-cost commercial Unmanned Aerial Vehicle (UAV) systems provides a great opportunity to leverage UAVs as a critical part of future post-launch validation activities of space-based environmental systems. GOES-R field campaign preparation efforts have initiated the evaluation of near surface UAV systems to address several heritage limitations and gaps in surface measurement and ground truth validation capabilities in support of post-launch validation of L1b and L2+ products. Two unique systems were investigated for near surface (≤ 20 m above ground level) collection: 1) Rotary UAV system to facilitate the collection of high quality goniometric observations of Earth surface targets; 2) Fixed-wing UAV system to facilitate the collection of surface observations of Earth targets over

extended regions. The capabilities investigated here will facilitate the transition of research to operations and advance the state-of-the-art of post-launch environmental validation capabilities of both L1b and L2+ products.

2-46 The Algorithm Workbench: Data-Driven Software for Ground Processing System Development, Test, and Operations
Authors: Alexander Werbos, David B. Hogan, Daniel Hunt, Erik Steinfelt & T. Scott Zaccheo

In this work, we present a software-based infrastructure comprised of interfaces and tools designed to effectively create, document, execute, and update software data processing systems. These interfaces and tools are specifically designed to reduce the overhead involved in traditional research to operations activities, and enable direct sharing of data processing algorithms across testing, development and production environments. The interfaces enable algorithms implemented in a variety of common programming languages to be adapted for use in this system. This can be done both for single-purpose algorithms seeking to leverage the power of the tools for an immediate need, as well as in the creation of enterprise-class algorithms designed for use across different instruments, platforms and missions. With these tools, users are able to create remote sensing data processing systems with complex precedence chains, audit the system for completeness, and execute the specified algorithms using either local or remote computational resources.

The key element of this system is the use of programmatically-accessible algorithm and product metadata at all phases of algorithm and system development. These metadata, provided in a database form, enables development of automated tools that replace the time-consuming and error-prone manual analysis, configuration management, and document management that often drives both direct and risk-related costs. In this design, they are collected in the Algorithm Descriptor Database (ADDB), which contains all information regarding algorithm inputs, outputs, and operational characteristics. These data are available to a variety of software, including the Algorithm Architect, a graphical user application that allows the user to visualize the system as they add or configure algorithms, and incorporates libraries that allow the automatic generation and execution of precedence trees.

The core components of the system are designed to be interoperable with a variety of off-the-shelf tools for data analysis and distribution, and provide a mechanism for ingesting inputs and generating outputs in a variety of self-documenting formats, including NetCDF/HDF, with standardized metadata, i.e CF-conventions. By combining the new functionality with tools commonly in use by the remote sensing community, users are able to conveniently assemble, analyze, and maintain complete

data processing and distribution systems with only minimal overhead.

2-47 Volcanic Cloud Detection, Characterization, Alerting, and Modeling Applications for GOES-R
Authors: Mike Pavolonis, Justin Sieglaff & John Cintineo

Previously developed methods for extracting quantitative information on volcanic clouds from satellite measurements have several important limitations that greatly reduce their significance for research and operational applications. No single method is capable of utilizing the entire volcanic cloud relevant space-based observing system to detect and characterize all major types of volcanic clouds (ash plumes/dispersed ash clouds and ice rich/opaque ash clouds) with the exceptional skill needed for automated alerting, model validation, and real-time data assimilation applications. To ensure that advanced sensors like the GOES-R Advanced Baseline Imager (ABI) are fully utilized, the National Oceanic and Atmospheric Administration (NOAA), in collaboration with the University of Wisconsin, has developed new techniques for automatically identifying clouds in satellite imagery that contain volcanic ash with much greater skill than previously demonstrated. The NOAA algorithm suite also contains procedures for automatically retrieving important volcanic cloud properties relevant to modeling applications and alerting forecasters when a volcanic cloud is detected. The NOAA methods are applicable to any volcanic cloud relevant satellite sensor, including the ABI, and can actually utilize combinations of satellite sensors to produce consistent, high quality, results. An overview of the applications developed for operational volcanic cloud monitoring and forecasting will be given.

2-48 Improved Engineering Analysis for GOES-R
Author: Bruce Twambly

Engineering Analysis (EA) is a requirement for most space missions, but is often poorly understood and poorly implemented. EA includes both Trending and Analysis which are complements that when combined cover a broad range of capabilities. Trending involves the comprehensive review of spacecraft telemetry to: observe changes in nominal behavior; detect impending failures; quantify periodic variations; and quantify and track expected changes in spacecraft characteristics. Trending is proactive, predictive, and automated and requires high-performance, modularity and extensibility. Analysis involves the targeted review of spacecraft telemetry to identify, characterize, explain, and workaround an observed anomaly or failure. Analysis is reactive, targeted, and interactive and requires flexibility, availability and interoperability.

When used together, Trending and Analysis define the full spectrum of capabilities necessary for satellite Engineering Analysis. However, given this scope it is

unreasonable to expect that a single application dropped into a ground system architecture will suffice.

ASRC Federal Technical Services supports the GOES-R Flight Project with the integration of the CASSIE™ Telemetry Analysis System developed by Astrofrontiers, Inc. CASSIE is an adaptable system of applications, libraries, and modules encompassing a highly efficient and portable decommutation engine that frees the EA functions from the idiosyncrasies and constraints of a mission's real-time T&C system. Visualization applications can be operated interactively and batched for off-line product generation. Project specific modules can be developed to import and export mission specific data formats. The system can be deployed in both thin and thick client contexts which enables powerful, remote monitoring and processing of telemetry. All of these capabilities can be developed atop a configurable Application Framework that provides commonality throughout the entire EA system.

2-49   Integrating Changes to JPSS Cross-Track Infrared Sounder (CrIS) SDR Algorithm using the Algorithm Development Library (ADL)

Authors: Vipuli Dharmawardane, Bigyani Das, Valerie Mikles & Walter Wolf

The Cross-Track Infrared Sounder (CrIS) is a Fourier transform spectrometer on board Suomi National Polar-Orbiting Operational Environmental Satellite System Preparatory Project satellite (S-NPP). CrIS provides measurements of Earth view interferograms with 1305 spectral channels in three infrared spectral bands at 30 cross-track positions, each with a 3 x 3 array of field of views. Joint Polar Satellite System 1 (J1) is the second generation spacecraft within NOAA's next generation polar-orbiting satellites that is planned to be launched in 2017. Having a similar instrument suite to S-NPP, J1 will utilize algorithms developed for S-NPP. The Interface Data Processing Segment (IDPS) has produced calibrated and geolocated truncated resolution spectra in the form of Sensor Data Records (SDR) in the S-NPP era, and currently revisions to the CrIS SDR algorithm are underway to support production of the full resolution J-1 SDRs within the IDPS. ADL is the test system that mimics IDPS and is used for testing, troubleshooting and integrating algorithm updates. In this poster we discuss the process that we use for testing the pre-operational full spectral resolution algorithm for product accuracy in the ADL environment before it is submitted to the ground project Data Products Engineering Services (DPES) for the unit testing. The testing, integration and the change request package preparation steps will be presented.

2-50   Preparing for GOES-R and JPSS at the Satellite Proving Ground for Marine, Precipitation and Satellite Analysis

Authors: Michael J. Folmer, Joseph Sienkiewicz, James Clark, Hugh Cobb, Nelsie Ramos, David Novak, Andrew Orrison, Jamie Kibler, Scott Rudlosky, Steve Goodman & Mitch Goldberg

The GOES-R and Joint Polar Satellite System (JPSS) Proving Ground Programs were conceived to demonstrate and familiarize forecasters with the next generation geostationary and polar-orbiting satellite products and capabilities that will be incorporated into NOAA operations. The 2014 satellite product demonstrations at the Weather Prediction Center (WPC), Ocean Prediction Center (OPC), National Hurricane Center (NHC) Tropical Analysis and Forecast Branch (TAFB), and Satellite Analysis Branch (SAB) of the National Environmental Satellite, Data, and Information Service (NESDIS) concentrated on convective applications that address rainfall and marine severe thunderstorm hazards. These pre-operational demonstrations allow forecasters to evaluate proxy and simulated GOES-R and JPSS data and refresh rate in a quasi-operational environment. Forecasters use proxy data from research and operational satellite instruments (GOES, MODIS, VIIRS, SEVIRI, among others), WRF model forecasts, and lightning networks to support their forecast and warning decision making. During product evaluations, forecasters help identify the strengths and limitations of the new GOES-R and JPSS capabilities prior to launch, providing valuable feedback to the product developers. Product developers then can use these evaluations to improve the operational versions.

This presentation focuses on proxy products that introduce the future capabilities of the Advanced Baseline Imager (ABI) and the Geostationary Lightning Mapper (GLM) on GOES-R as well as the current capabilities of the Advanced Technology Microwave Sounder (ATMS) and Visible Infrared Imaging Radiometer Suite (VIIRS) on S-NPP. Multispectral imagery allows forecasters to better analyze phenomena like Saharan dust interaction with tropical cyclones and stratospheric intrusions in the vicinity of strong extratropical cyclones. GOES-14 has provided the unique opportunity to evaluate the operational utility of 1-min super rapid scan imagery. Forecasters can integrate other products with the high resolution imagery for situational awareness at refresh rates that are faster than radar. The Overshooting Top Detection (OTD) algorithm is being demonstrated at the OPC and TAFB to help forecasters locate the most intense convection in the offshore waters where radar is not available. The OTD also is being used to help SAB and WPC forecasters identify potential excessive rainfall areas. A GLD360 lightning density product was developed through coordination between OPC, the Cooperative Institute for Climate and Satellites (CICS), and NESDIS/STAR, in coordination with the Pseudo-Geostationary Lightning Mapper (PGLM) product developed by NASA SPoRT. The GLD360 product is available for 2-min, 5-min, 15-min, and 30-min intervals and helps forecasters to better quantify the intensity of cloud-to-ground lightning activity at the GLM 8 km

resolution. Additional products such as the GOES-R Convective Initiation (CI) and Nearcast are becoming more integrated in the forecaster's toolbox. Our presentation will provide animations and feedback on particular events to illustrate product uses and lessons learned.

2-51 Use of JPSS ATMS and VIIRS data to Improve Tropical Cyclone Track and Intensity Forecasting
Authors: Galina Chirokova, Mark DeMaria, Robert DeMaria, John Knaff, Jack Dostalek & John L. Beven

The JPSS instruments, namely the Advanced Technology Microwave Sounder (ATMS) and the Visible Infrared Imaging Radiometer Suite (VIIRS), carried by the Suomi National Polar-Orbiting Partnership satellite (SNPP) provide unique information that could be critical for the forecasting of tropical cyclones (TC) track and intensity and is currently underutilized. Our group is developing several new TC applications using data from JPSS instruments. The overview of three applications, as described below, will be presented together with a discussion of future plans.

(1) The Maximum Potential Intensity (MPI) application uses ATMS temperature and moisture retrievals in the near storm environment to estimate storm MPI and use it as input to statistical tropical cyclone intensity forecast models, the Statistical Hurricane Intensity Prediction Scheme (SHIPS), the Logistic Growth Equation Model (LGEM), and the Rapid Intensification Index (RII) to improve their performance. Improving TC rapid intensification forecasts is an especially difficult but very important forecast problem which is one of the highest priorities within NOAA. Preliminary statistics show that using ATMS-based MPI as input to the RII results in an improvement of the Brier Skill Score and bias for both the Atlantic and West Pacific basins. The Atlantic basin in particular saw a 3.1% bias decrease. Additionally, the LGEM intensity forecast for the East Pacific basin is improved for 0-48 hr forecast times. Improved MPI estimates obtained by combining ATMS temperature and moisture profiles with dropsondes and GFS profiles in the vicinity of TCs will presented.

(2) The objective automated eye-detection application uses GOES and VIIRS data in combination with techniques from the fields of machine learning and computer vision to investigate the utility of objective techniques to perform eye detection. Determining the onset of eye formation is very important for intensity forecasts and center estimation. Currently, most existing operational eye detection methods are subjective and little investigation has been made into the use of objective techniques. The automated infrared (IR)-based eye-detection algorithm showed very promising results, with a 75% success rate. The results of further refining the eye-detection algorithm using VIIRS data will be presented.

(3) Examples of storm-relative VIIRS imagery, especially the unique day-night band (DNB) imagery that has multiple uses for TC forecasting, such as detecting low-level circulation centers, will be presented together with the discussion of improving the utility of VIIRS imagery for TC track and intensity forecasting.

2-52 Processing Himawari-8 Geostationary Satellite Data Using GOES-R Algorithms for Algorithm Continuity in Operations
Authors: Jonathan Wrotny, A. Li, H. Xie, M. Fan, R. Chen, T. Yu, S. Sampson, W Wolf, W. Straka, A. Heidinger & J. Daniels

The GOES-R Algorithm Working Group (AWG) Algorithm Integration Team (AIT) maintains and updates a data processing framework for the GOES-R algorithm processing. This system provides an environment for algorithm development and testing along with the ability to process multiple algorithms in sequence with product precedence. Most of the AWG algorithms are already able to process on different satellite datasets and simulated data. With the launch of the Japanese Himawari-8 satellite in October 2014, data from this next-generation geostationary satellite is now available for algorithm testing. The Himawari-8 satellite is applicable to GOES-R since its primary monitoring instrument is the Advanced Himawari Imager (AHI) which is a close proxy of the GOES-R Advanced Baseline Imager (ABI) instrument. The AHI has the same number of spectral channels with most at similar wavelengths as the ABI, and the temporal and spatial resolutions of the data are also alike. Since the GOES-R satellite has not yet launched, there is an opportunity to use AHI data as input to the GOES-R data processing 'Framework' in order to further test the current GOES-R algorithms.

This poster describes updates made to the GOES-R Framework to process AHI data for algorithm use. In particular, we focus on updates to the Derived Motion Winds algorithm required for it to process on AHI data. These updates include new readers for ingesting AHI radiance, reflectance, brightness temperature data, and satellite auxiliary data as well as new tables for AHI specific configuration variables and coefficients required for algorithm processing. The Cloud Mask, Cloud Height, and Cloud Phase algorithms are also adapted for AHI data since these algorithms are needed as inputs to the Winds algorithm. Example retrieved wind images are shown. In the future, the Derived Motion Winds algorithm will be an operational demonstration running in near real-time as data is obtained from JMA. Additionally, the other AWG GOES-R algorithms will be adapted for AHI-data processing.

2-53 Impact Analysis of LEO Hyperspectral Sensor IFOV size on the next generation NWP model forecast performance

Authors: Agnes Lim, Zhenglong Li, James Jung, Allen Huang, Jack Woollen, Greg Quinn, FW Nagle, Jason Otkin & Mitch Goldberg

Increase computational resources and improvements in forecast model physics have allowed forecast models to be run at higher grid resolution, thus resolving more features. Rapid increase in the number and better use of satellite observations through data assimilation have also reduced error in the initial conditions required by forecast models. These factors have led to a steady improvement of forecast skill in the past three decades.. These improvements will help in defining with greater fidelity the critical extreme weather events. Operational Numerical Weather Prediction (NWP) centers throughout the world are moving in the direction high spatial resolution forecasts. The European Centre for Medium-Range Weather Forecasts (ECMWF) is planning to increase their global model resolution from 16km to 10km by 2015 and target to achieve a 5km resolution by 2020. The National Centers for Environmental Prediction (NCEP) had increased her global model grid resolution to 13km in January 2015.

Under clear sky assimilation, cloud detection will be an important quality control that rejects observations from assimilation for a hypersepctral infrared sounder such as Cross-track Infrared Sounder (CrIS). A smaller CrIS field-of-view (FOV) will have a higher probability of being free from cloud contamination. Thus the number of CrIS observations entering the data assimilation process and making a larger contribution to the analysis.

Impact of FOV size for CrIS on NWP will be assessed through satellite data assimilation using the NCEP Global Forecast System (GFS). Impact assessment will be performed in a simulated environment, also known as an Observing System Simulation Experiment (OSSE), as CrIS with a smaller FOV is not available on any of the present satellites. CrIS observations at both the current and increased resolution are simulated from a known state of the atmosphere or the Nature Run. The control run assimilates CrIS observations at the current resolution, which is about 14km at nadir; and the experiment run assimilates CrIS observations that have a smaller FOV. Forecasts between the two runs will be evaluated. These experiments will be conducted in the presence of all current major observing systems. Prior to carrying out the CrIS experiments, the OSSE system will be calibrated against the real system to verify that the simulated data impact by comparing it to the real data impact.

2-54   Using GOES Imagery as Pointing Truth for TEMPO Image Navigation and Registration

Authors: Kerrie Allen, James L. Carr, Brad Pierce, Joseph Fox-Rabinovitz, Norman Lo & David Zakar

The Tropospheric Emissions: Monitoring of Pollution (TEMPO) instrument will observe tropospheric O_3, NO_2, and other trace gases as part of NASA's Earth Venture Instrument (EV-I) program. TEMPO will be hosted onboard a geostationary communications satellite to allow for continuous observation of CONUS and parts of Canada and Mexico. As an EV-I hosted payload, TEMPO will not have the same Image Navigation and Registration (INR) capabilities available to it that an observatory-class mission such as GOES-R would have. Our poster describes how TEMPO's ground system will take advantage of GOES imagery to provide pointing truth for its INR algorithm. Normally, it is difficult to compare imagery from geostationary satellites at different nominal longitudes, due to the parallax from the height of objects above the ellipsoid. We describe how parallax can be managed and in particular how GOES-East and West can be used simultaneously to enable binocular vision and compensate for the parallax of unknown objects. Tie point geographic offsets are then used to drive TEMPO's Kalman filter, which tracks and smooths knowledge of the system state, and enables determination of scan parameters that keep the imagery centered over the CONUS. Feasibility of this concept has been shown through a Matlab validation prototype and the full system is currently in development.

2-55   On the Use of 1-Minute Satellite Imagery in the Storm Prediction Center

Author: Bill Line

The Geostationary Operational Environmental Satellite R-Series (GOES-R) Proving Ground (PG) provides the Storm Prediction Center (SPC) in Norman, OK with an opportunity to evaluate various GOES-R proxy products and capabilities in operations on a year-round basis. Through these activities, the PG seeks to increase forecaster awareness and preparedness for the upcoming launch of GOES-R, and to collect user feedback for continued product development. PG activities within the SPC are focused on how GOES-R can help the SPC complete its mission of issuing timely and accurate short-term forecast products for high-impact mesoscale weather events.

Geostationary satellite imagery is a vital component to the success of the SPC mission. Water vapor imagery helps forecasters to analyze the recent synoptic scale evolution of the atmosphere and anticipate how those changes might influence future convective development. Meanwhile, visible satellite imagery is analyzed closely during all stages of convective evolution for the identification and tracking of various features and processes. A few examples include: low-level boundaries, convective initiation, and overshooting and collapsing storm tops. Finally, infrared satellite imagery is utilized at night and for the observation of cloud top temperature changes.

SPC forecasters have had the opportunity to evaluate the utility of Super Rapid Scan Operations for GOES-R (SRSOR) 1-minute imagery via GOES-14 in operations during two week demonstration periods that occurred in August 2013, May 2014, and August 2014. The SRSOR

demonstrates a capability of the GOES-R Advanced Baseline Imagery (ABI), which will have a temporal update frequency of up to 30 seconds over a 1000x1000 km sector. Higher temporal resolution satellite imagery helps forecasters to observe the aforementioned features and processes with enhanced detail, timeliness, and clarity. Case studies showing the utility of the 1-min satellite imagery to SPC operations are presented. Additionally, results from evaluations in SPC involving GOES-R products that benefit from increased temporal resolution will be discussed.

2-56 Improve volcanic ash simulation with Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) dispersion model by assimilating satellite observations

Authors: Tianfeng Chai, Alice Crawford, Barbara Stunder, Roland Draxler, Michael J. Pavolonis, and Ariel Stein

Currently NOAA National Weather Service (NWS) runs the Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) dispersion model with unit mass release rate to predict the transport and dispersion of volcanic ash. The model predictions provide information for the Volcanic Ash Advisory Centers (VAAC) to issue advisories to meteorological watch offices, area control centers, and flight information centers. Quantitative forecasts can be generated by estimating the volcanic ash source terms based on the satellite retrievals of volcanic ash mass loadings. Recently an emission inversion system has been built based on the HYSPLIT dispersion model and a three-dimensional variational data assimilation (3D-Var) approach. It was able to recover the 2011 Fukushima nuclear accident radionuclide releases using global air concentration measurements. This emission inversion system is further extended here to assimilate satellite observations of volcanic ash. In this study, the MODIS (MOderate Resolution Imaging Spectroradiometer) volcanic ash mass loadings are used to estimate the source terms distributed at various time and heights for one volcanic eruption. The impact of such satellite-observation-constrained source terms on the forecasts will be assessed using the subsequent observations which are not assimilated.

2-57 An Initial Comparison of NASA GPM Precipitation Products to NOAA operational Products

Authors: Ralph Ferraro, Nai-Yu Wang, Yalei You, Patrick Meyers & Huan Meng

NASA's Global Precipitation Measurement (GPM) Mission was launched in February 2014, nearly 1 year ago. NOAA scientists have been active participants on the GPM Science Team, and have contributed to the "day 1" passive microwave radiometer algorithm for the GPM core and constellation satellites. This algorithm, denoted GPROF2014, is still undergoing evaluation and will be upgraded to a "day 2" algorithm after a robust

database of colocated GPM Microwave Imager (GMI) and Dual Frequency Precipitation Radar (DPR) is obtained. In the meantime, NOAA has performed some preliminary evaluations over the CONUS through comparisons of GPROF2014 with our own operational product suite, including those from the Microwave Integrated Retrieval System (MiRS), GCOM AMSR-2 (GPROF2010V2) and the NESDIS snowfall rate (SFR), to name a few. This poster will present both qualitative and quantitative comparisons covering a variety of synoptic precipitation events to demonstrate the strengths and weaknesses of GPROF2014. Finally, as part of our ongoing collaborations with NASA, we will present some comparisons with a new prototype GPROF algorithm devoted to microwave sounders through some comparisons with S-NPP ATMS and DMSP SSMIS.

2-58 The VIIRS Active Fire Data for Fire Management: A review of the Proving Ground and Risk Reduction (PGRR) Project efforts

Authors: Evan Ellicott, Ivan Csiszar, Wilfrid Schroeder, Louis Giglio & Chris Justice

The Active Fire (AF) product is one of the operational environmental data products generated from the Visible Infrared Imaging Radiometer Suite (VIIRS) sensor on the Suomi National Polar-orbiting Partnership (SNPP) satellite and has demonstrated to be critical for disaster and resource management, specifically wildland fire incidents.

The Proving Ground and Risk Reduction (PGRR) project was created to maximize the benefits and performance of NOAA's satellite assets with the primary objective of the VIIRS AF PGRR project being to improve AF data, algorithms, and products for downstream operational and research users (gateways to the public). The process includes product evaluation, validation, and improvement while collaborating with the wildland fire user community to develop product understanding, dissemination, and ultimately to leverage the VIIRS AF products for active and post-fire management. In 2014, the Suomi NPP IDPS active fire product was declared Operational for NOAA real-time applications (primarily for used within NOAA's Hazard Mapping System). As the VIIRS sensor, and the AF in particular, has become more visible to the research and operations community there has been a greater urgency to assess the accuracy of the product and engage the end-users. Discussion with end-users has focused on several components, including such a basic information as spatial resolution, sampling aggregation and sources to obtain the product(s). In addition, explanation of the similarities and differences with the MODIS sensor and AF product has been necessary to aid in the transition to VIIRS. A critical facet of these discussions is the opportunity to field questions and gather user feedback of the VIIRS AF product. Finally, our evaluation and validation efforts through prescribed burns have

provided opportunities to work closely with the end-users such as the U.S. Forest Service and members of the Southern Africa Fire Network (SAFnet).

This presentation will discuss some our efforts within the PGRR project including outreach and education and product evaluation and validation.

2-59   High-resolution Atmospheric Motion Vectors (AMVs) for application in high-impact weather events in the GOES-R era
Authors: Christopher Velden, Jaime Daniels, David Stettner, Steve Wanzong & Wayne Bresky

The GOES-R Algorithm Working Group and Risk Reduction activities are supporting the development, validation and model impact testing of high-resolution (space and time) AMVs derived from rapid-scans for applications in high-weather events such as hurricanes and severe weather. This study covers the testing of new AMV production algorithms expected to be operational in the GOES-R era, and numerical model data assimilation experiments designed to exploit the full information content of the high-resolution data in mesoscale analyses. Examples from Hurricane Sandy (2012) will be presented.

2-60   Evaluation of the impact of satellite radiance data within the hourly Rapid Refresh data assimilation system
Authors: Haidao Lin, Steve Weygandt, Ming Hu, Curtis Alexander & Stan Benjamin

On February 2014, the NOAA operational Rapid Refresh (RAP) hourly updated prediction system running at the National Centers for Environmental Prediction (NCEP) has been upgraded to version 2. The data assimilation system is now the advanced Gridpoint Statistical Interpolation (GSI) hybrid variational/Ensemble Kalman Filter (EnKF) data assimilation system. Ensemble information needed in the regional assimilation comes from the 80-member global ensemble data assimilation system.

Our previous studies had demonstrated that the assimilation of satellite radiance observations produced positive impact on short-range forecasts within the RAP model system. In preparation for operational implementation of RAP version 3 planned for middle of 2015, a series of new updates for satellite radiance data assimilation and model improvements are being tested at the Global System Division (GSD) of the NOAA Earth System Research Laboratory (ESRL). These updates include the use of enhanced bias correction scheme, revised channel selection for existing sensors, assimilating observations from new instruments, and the use of the Regional ATOVS Retransmission Services (RARS) real-time data sets.

The impact of radiance updates in RAPV3 has been tested and evaluated through a series of one-month retrospective runs as well as multi-month real-time runs. The experiments with radiance data assimilated conventional data and all radiance data planned for the RAP version 3. Radiance data assimilated include observations made by AMSU-A, HIRS, MHS, AIRS, and GOES as well as the real-time RARS data with short data latency. The runs without radiance data assimilated only conventional data. The impact from assimilating radiance data in the RAP system is evaluated in terms of short-term forecast skill. The impact among radiance data, aircraft data, and radiosonde data is also compared and evaluated through data denial retrospective experiments. We will report on the recent radiance assimilation updates as well as results obtained from the retrospective experiments and the multi-month experiments performed in real time environment.

3-1   3D Printing with CLASS: Making Models for Education and Outreach Using Satellite Weather Imagery
Author: Francis Reddy

Infrared and visible satellite imagery suitable for constructing simple 3D models of synoptic weather systems is readily available through NOAA's Comprehensive Large Array-Data Stewardship System (CLASS). Physical models provide a compelling way for students and the public to compare the sizes and 3D structures of large storms, such as tropical cyclones, hurricanes, and typhoons. The increased availability of 3D printers, coupled with free and low-cost software for developing digital models, puts this capability in the hands of students, educators, and outreach professionals. Presented here are 3D-printed models of Hurricanes Julio, Katrina, and Sandy derived from infrared and visible images acquired by NOAA's GOES satellites, together with an outline of how they were produced. The files for printing these models are publicly available on NASA's 3D Resources website (http://nasa3d.arc.nasa.gov).

3-2   Mapping Floods due to snowmelt and ice jam in Alaska Area using NPP VIIRS data
Authors: Donglian Sun, Sanmei Li, Bill Sjoberg & Mitch Goldberg

Floods are one of the most frequent natural disasters at global scales. In the United States, floods result in more loss of life and property than other types of severe weather events. The Northeast and North Central U.S., and some areas of the Western U.S. are particularly susceptible to snowmelt and ice-jam flooding. In this study, we present an approach to estimate the extent of floods due to snowmelt and ice jam in high latitude region, like Alaska, where conventional observation is sparse, satellite data is very useful and helpful. The approach estimates the water fraction from coarse-resolution VIIRS (Visible Infrared Imaging Radiometer Suite) data through mixed-pixel linear decomposition. Based on the water fraction difference, the flood map can be derived from the VIIRS measurements. Currently, our VIIRS flood product is running under the Community Satellite Processing Package (CSPP: http://cimss.ssec.wisc.edu/cspp/) and has been implemented successfully into the Advanced Weather Interactive Processing System (AWIPS) – a technologically-advanced processing, display, and telecommunications system that is the cornerstone of the United States National Weather Service's (NWS) operations. Our algorithms are now on the way for operational applications in snowmelt and ice-jam flood monitoring and early warning in Alaska & Pacific River Forecast Center (APRFC) and North Central River Forecast Center (NCRFC). As part of generating the river flood product routinely, the NCRFC-sector images are uploaded to RealEarth. This will allow those users without the AWIPS to easily view the near real time (NRT) flood products. This is a link to the product, which should always bring up the latest image: http://wms.ssec.wisc.edu/s/A8LT. With more efforts and support from the NOAA JPSS Program Office, the VIIRS flood product can be further improved and thus provide better applications in these floods for wide end users.

3-3   Analysis of sea surface sound speed near the Changjiang River mouth using passive microwave remote sensing
Author: Bumjun Kil

Remote sensing based sound speed (SSP) of sea surface was studied for the low salinity region in the East China Sea during the summer monsoon season. Sea surface temperature (SST) from NASA Tropical Rainfall Measuring Mission (TRMM) and sea surface salinity (SSS) from ESA Soil Moisture and Ocean Salinity (SMOS) satellite were used to calculate the sea surface SSP. In this research, using sound speed formula, the advent of Acoustic Channel due to the unpredictable expansion of freshwater from Changjiang River was speculated by comparing satellite-based surface SSP with subsurface SSP from numerically predicted salinity and temperature. Because the Acoustic Channel occurs below the surface when the surface SSP is lower (e.g. low SST or extremely low SSS) than subsurface, its horizontal distribution may provide good understanding for the acoustical impact of expanding freshwater into the open ocean.

3-4   Synthetic Satellite Imagery: A New Tool for GOES-R User Readiness and Cloud Forecast Visualization
Authors: Dan Lindsey, Louie Grasso & Dan Bikos

For the past several years, synthetic satellite imagery has been produced at the Cooperative Institute for Research in the Atmosphere (CIRA) in collaboration with the NOAA/NESDIS/StAR Regional and Mesoscale Meteorology Branch. Output from convection-resolving models is used as input to a radiative transfer model, which calculates the brightness temperatures expected from satellites. The result is a time series of forecast satellite images.

Synthetic imagery of spectral bands from the GOES-R Advanced Baseline Imager are currently being used in training efforts for the National Weather Service (NWS). It is very beneficial for forecasters to preview the type of information that will become routine from GOES-R in less than 2 years. Another huge benefit is that synthetic imagery is an excellent visualization tool for clouds from these high resolution models. The NWS offices that are receiving the data in real time from CIRA have provided overwhelmingly positive feedback.

This presentation will provide an overview of GOES-R synthetic imagery, including its utility in user readiness and its use by forecasters as a model visualization tool.

3-5 Improvements to SCaMPR Rainfall Rate Algorithm

Authors: Yan Hao, Robert J. Kuligowski & Yaping Li

The GOES-R Rainfall Rate algorithm, which is also called SCaMPR (Self-Calibrating Multivariate Precipitation Retrieval), is an effort to combine the relative strengths of infrared (IR)-based and microwave (MW)-based estimates of rain rate. It uses MW rain rate retrievals as it's calibration standard for a GOES-based retrieval, which allows MW rain rates to be used in an operational forecasting environment because of its much shorter latency (minutes) relative to other products that use MW rain rates directly.

A simplified version of the algorithm has been run in real time on current-generation GOES since August 2011 and has been evaluated by National Weather Service field forecasters via collaboration with the NASA Short-term Prediction Research and Transition Center (SPoRT). Their feedback has resulted in several improvements to the algorithm, include employing a relative humidity (RH) correction for sub-cloud evaporation, incorporating Q3 data into SCaMPR as a supplemental data set to MW-based rainfall rates estimates, and employing smaller calibration regions for more localized and more accurate calibration.

This presentation will describe the basic GOES-R Rainfall Rate algorithm as well as its recent improvements and will compare its performance with the current operational GOES algorithm.

3-6 Green Vegetation fraction derived from the Visible Infrared Imaging Radiometer Suite (VIISR) sensor onboard the SNPP satellite

Authors: Zhangyan Jiang, Marco Vargas, Junchang Ju & Ivan Csiszar

Green Vegetation fraction (GVF) is defined as the fraction of a pixel covered by green vegetation when viewed from nadir. Real-time GVF is needed in numerical weather, climate and hydrological models. The current NOAA operational GVF product is derived from AVHRR top of atmosphere NDVI data at 16-km resolution. The new GVF product is derived from data from the Visible Infrared Imaging Radiometer Suite (VIIRS) on board the Suomi National Polar-Orbiting Partnership (SNPP) satellite. GVF is a NOAA-Unique Product (NUP) for applications in numerical weather and seasonal climate prediction models at the National Centers for Environmental Prediction (NCEP). The retrieval algorithm uses VIIRS red (I1), near-infrared (I2) and blue (M3) bands centered at 0.640 µm, 0.865 µm and 0.490 µm, respectively, to calculate the Enhanced Vegetation Index (EVI), and derive GVF from EVI. To

meet the data needs of NCEP and other potential users, GVF maps are produced as daily rolling weekly composites at 4-km resolution (global scale) and 1-km resolution (regional scale). A preliminary validation was conducted and the results showed that the global and regional VIIRS GVF products meet the design requirements.

3-7 Two New Multi-Spectral Composite Satellite Products and their Use by NWS Alaska Region in Identifying Low Clouds and Fog

Authors: Eric Stevens, Kevin Fuell, Lori Schultz & Matt Smith

Using an approach originally developed at EUMETSAT, NASA's Short-Term Prediction Research and Transition Center (SPoRT) has worked with the Geographic Information Network of Alaska (GINA) at the University of Alaska to generate two multi-spectral composite, or "RGB," products by combining several MODIS and VIIRS channels into single images. The raw MODIS and VIIRS data are received via direct broadcast by GINA, and the resulting multi-spectral composite imagery is distributed in near real time for use by the National Weather Service in Alaska. The RGB Night-Time Microphysics and RGB 24hr Microphysics products highlight the presence of low clouds and fog which can negatively impact aviation and the general public, particularly in areas of complex terrain. Ideally, these new MODIS and VIIRS products will provide value beyond the capabilities of traditional satellite imagery such as the infrared channel differencing "fog product." It is also hoped that these products will be of particular use in Alaska due to the comparatively high frequency of coverage from the MODIS and VIIRS instruments at higher latitudes, and because coverage from other in-situ weather observations such as METARs and WSR-88Ds is quite limited over much of Alaska.

3-8 The Unique Radiometric Calibration Trending Behavior of the GOES Imagers and Sounders

Authors: Kenneth Mitchell, Merrisa Griffin & J. Paul Douglas

The users of GOES Imager and Sounder environmental data products benefit from the accurate and stable radiometric calibration in the infrared (IR) channels. Although the calibrated data products are radiometrically stable, each instrument's response is usually far from stable, being affected by a combination of: the intrinsic radiometric performance of the instrument's component parts; the diurnally changing temperature environment; and episodic changes to GOES spacecraft and instrument operations. The transition from the radiometrically unstable IR data collection to the stable data products is made via the use of onboard blackbody calibration targets which are observed 2 or 3 times each hour (the calibration also includes measurements of space to get radiometric biases). Specifically, the calibration data from the blackbody targets is used by the ground software to calculate updated radiometric

gain coefficients at the time of each blackbody observation. These coefficients follow the dynamically changing instrument gain, and are used to calibrate the raw Earth-pointing data. The gain coefficients are stored in a mission-long archive for the purposes of monitoring instrument radiometric performance and subsequent data analysis. The operational monitoring of these radiometric calibration gains is a key tool for following the general health and performance of the GOES Imagers as well as for recognizing and addressing specific instrument anomalies. However the first step in operational monitoring is to understand the unique, inherent (i.e. normal) trending signatures of each instrument. As an example of this first step, this poster presents the annual trending behaviors of the radiometric gains in one wavelength-channel for the Imagers and Sounders onboard the GOES-13 (East), -14 (in storage), and -15 (West) satellites. The basic, repeatable features in each instrument's radiometric trend plot are noted and explained in terms of the instrument's unique radiometric characteristics (e.g. the non-nominal behavior of an instrument component) and/or the commanded changes to the operational state of the spacecraft/instrument (e.g. necessary changes to the detector's control temperature).

3-9   Stereo Cloud Top Height Products for the GOES-R Era
Authors: Houria Madani & James L. Carr

An Internal Research and Development (IRAD) effort to create a prototype stereo cloud top height (Stereo-CTH) product from GOES satellite imagery is described. The Stereo-CTH product is based on matching images of the same or similar spectral bands acquired quasi-simultaneously by GOES satellites from two or three different vantage points. A prototype of the Stereo-CTH algorithm is developed and tested with GOES data that were acquired when all three GOES-NOP satellites (13, 14 and 15) were operational simultaneously. Two sets of GOES data are used: one set was acquired at the time of the 2012 Sandy hurricane and the other data set is from the summer of 2013. The Stereo-CTH IRAD effort is a continuation of work performed with the Tropospheric Emissions: Monitoring of Pollution (TEMPO) mission which offers the capability to measure cloud top height effectively out to at least 60° Earth Central Angle (ECA) as a byproduct of TEMPO's Image Navigation and Registration (INR) processing.
The simultaneous availability of three GOES satellites, once GOES-R is launched and begins it Post Launch Testing (PLT), makes the Stereo-CTH a good candidate for a multi-satellite product. Even after one of the GOES NOP satellites is retired and only two satellites are operational simultaneously, it will be possible to make a Stereo-CTH product. The coverage out to 60° ECA where we can measure CTH with three GOES satellites is defined by the overlap of the coverage areas from any two of the three satellites (GOES-E and W, and GOES-R in its PLT configuration): the combined overlaps is nearly

a full disk. Similarly, when using two GOES satellites, the coverage of the Stereo-CTH product is defined by the overlap of the two areas that constitute the satellite coverage for GOES-E and W. Imagery from other satellites (TEMPO, VIIRS, MSG,) can also be used as a third data set when only two GOES satellites are operational at once. The TEMPO geographic coverage combined with two GOES satellites in their operational East and West configurations allows for making a Stereo-CTH product for most of the CONUS sector.

3-10   Overview of the Limb Imaging Spectrometer
Authors: Xiaohu Yang, Yu Huang & Shurong Wang

The Limb Imaging Spectrometer (LIS) is part of a joint experimental project of CIOMP and IAP from CAS, designed for collecting global limb spectral data, together with establishing atmospheric species retrieval algorithm and making some other correlative scientific research. LIS will be on XX-2 spacecraft to be launched in 2016 for the Chinese Space Station. Conceptually, LIS is a passive imaging spectrometer, comprising a calibration wheel, a telescope, a spectrometer, and thermal and electronic subsystems. And its wavelength range is 290-1000nm. The calibration wheel with 6 holes distributing uniformly is ahead of the LIS. An off-axis parabolic reflector with no chromatic aberration and corrected spherical aberration has been used for the telescope system. The overall spectrometer design adopts a new optical assembly whose dispersion element is prism and whose collimating and imaging mirrors are ellipsoidal and hyperboloidal separately. A mirror introduced between the entrance slit and the collimating mirror, can fold the light path to a compact one. The rear-coated prism, instead of the traditional Littrow mirror and the large-bore lens in the light path, works in a reflective way and also makes the optical construction simplified and the size and weight reduced. Light coming out of the spectrometer will be projected onto an e2v' s 47-20 CCD detector and then converted into electronic signal. LIS has an Instantaneous Field of View (IFoV) of 0.02 degrees (spectral dimension) x 2.4 degrees (spatial dimension), a focal length of 69.2mm and an F# number of 6.92. The spatial resolution of LIS is better than 3km at 400km height, and the spectral resolution is better than 1.8nm in 290nm. In order to increase the signal-to-noise ratio, both a thermo electric cooled technology and a 4 (spectral dimension) x 6 (spatial dimension) pixel binning technology have been adopted. Additionally, two LED lamps have been used for an on-board linearity measurement to monitor the possible variation of the detector. Since there is no lamp for wavelength and radiometric calibration in flight, LIS will use the solar Fraunhofer lines to correct the wavelength variation and the solar occultation mode to monitor the instrument degradation. LIS is such a new imaging spectrometer which can achieve both a 10~60km limb altitude and a 290~1000nm spectral range detecting with only one CCD. It will become an

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important supplementary to the global limb spectrum and the solar irradiance measurement.

3-11   NOAA / NESDIS Operational Air Quality Satellite Products

Authors: Liqun Ma, Hanjun Ding & Zhaohui Cheng

The NOAA National Environmental Satellite and Data Information Service (NESDIS) is operating, developing, and hosting numerous satellite-derived products for use by the air quality community. This poster presentation provides a cursory review of the products and outlines their relative merits as tools for air quality applications.

3-12   Use of NOAA Satellite Date by the Bahamian Meteorological Service

Author: Gregory Gibson

3-13   Using the NOAA Unique CrIS/ATMS processing System (NUCAPS) to explore hyper-spectral sounding capabilities during extreme events: lessons learned from the CalWater 2015 campaign

Authors: Antonia Gambacorta, Christopher Barnet & Mitchell Goldberg

The objective of this talk is to explore and demonstrate the vertical profiling capabilities of hyper-spectral soundings in capturing high impact mesoscale phenomena over the otherwise poorly sampled Pacific Ocean region. The high vertical resolution and spatial coverage of hyper-spectral sounders is a key element to fill this critical observational gap.

We use the NOAA Unique CrIS/ATMS Processing System (NUCAPS) to retrieve vertical profiles of temperature and relative humidity from the Suomi-NPP CrIS/ATMS instruments suite distributed in near real time (less than 1.5 hours) by the CSPP Direct Broadcast. These profiles are collocated to a large number of correlative soundings from the GFS and ECMWF model analyses and in situ radiosonde measurements collected over the North East Pacific during the occurrence of CalWater 2015. Focus of this intensive field campaign, which took place in the months of January and February 2015, was a close study of atmospheric river phenomena and their impact on extreme precipitation events over the West coast of the United States.

This paper attempts at performing two main investigations. A first comparative analysis is aimed at validating the robustness of the NUCAPS retrievals under high relative humidity and cloudy conditions. Secondly, we aim at showcasing the beneficial additional information of the NUCAPS soundings over the model analyses, in defining crucial moisture structure (position, water vapor content, amplitude) in the vicinity of the complex mesoscale activity associated to the development and landfall of atmospheric river phenomena. This study is aimed at providing a proving ground for assimilation of NUCAPS retrievals into regional model forecasting with the scope of ultimately reducing diagnostic and forecast errors associated with extreme precipitation events such as those caused by atmospheric rivers landfalls over the Western United States.

3-14   Access to GOES-R Satellite Data and Products with McIDAS and Mobile Apps

Authors: D. Santek, R. Dengel, S. Batzli, D. Parker & N. Bearson

At the Space Science and Engineering Center (SSEC), the Man computer Interactive Data Access System (McIDAS) has been the cornerstone for satellite data visualization since the early 1970s. It continues to be used worldwide for research, educational purposes, operational product generation, and in forecasting at NOAA centers and international weather offices. There are two supported versions of the software: McIDAS-X (heritage) and McIDAS-V (Java-based).

In preparation for GOES-R, SSEC is in the process of enhancing the core McIDAS-X and –V software packages to import the data and products from the ABI and GLM in netCDF format. For McIDAS-X to incorporate these new data, Abstract Data Distribution Environment (ADDE) servers are being developed. McIDAS-V is already netCDF-capable, so we have been testing with simulated data at this time.

To take advantage of emerging web-mapping and mobile technologies, SSEC recently developed a server-based, extensible infrastructure called "RealEarth™" that can process satellite imagery and related data into formats optimized for display and manipulation in web browsers and native mobile device apps. The system is robust: over 240 imagery and data products are viewable in the RealEarth browser at http://realearth.ssec.wisc.edu. RealEarth is the backend for our mobile app, WxSat, which is available for iOS and Android phones and tablets. Currently, WxSat displays only near real-time visible, infrared, and water vapor global composite imagery. A GOES-R customized mobile app is in the early stages of development that will provide user-configurable, real-time access to the GOES-R data and products suite.

This presentation will provide the status of:
• ADDE servers for ABI channel data, Level 2, and Level 2+ products
• ADDE server for GLM data
• McIDAS-V access to GOES-R data and products
• Access to GOES-R data and products in RealEarth and mobile apps
• McIDAS-X and McIDAS-V readiness for Himawari-8 AHI data

3-15   Python Access to Real-time and Archive Satellite Data

Authors: Jerrold Robaidek, Ray Garcia, Eva Schiffer, Dave Santek, Tommy Jasmin, Kevin Hallock & David Stettner

The University of Wisconsin Space Science and Engineering Center (SSEC) Data center receives data from over 20 satellites and redistributes that data in near-realtime. It also has one of the largest archives of geostationary weather satellite data in the world. The archive contains data from every GOES Satellite and spans 35+ years. In addition, 15 years of international geostationary satellite data are also in the archive. All of these data are accessible using McIDAS Abstract Data Distribution Environment (ADDE). ADDE provides on-demand access with instant download of data from remote servers. Moreover, the ADDE protocol includes the ability to subset the data both spectrally and spatially, and return the data in requested units (e.g., radiance, brightness temperature). However until recently, ADDE access to these datasets were only accessible to McIDAS-X, McIDAS-V, and Unidata IDV clients. This presentation will describe a new way to access real-time and 35+ years of geostationary satellite data within a python environment. By providing a modern python interface to the proven ADDE data transfer protocol, satellite data archive users will have an easy and powerful access to the SSEC Data Center holdings.

3-16   A CERES-Consistent Cloud Property Climate Data Record Using AVHRR Data
Authors: Patrick Minnis, Kristopher Bedka, David Doelling, Seiji Kato, Qing Trepte, Sarah Bedka, Benjamin Scarino, Chris Yost, Konstantin Khlopenkov, Gang Hong, Mandana Khaiyer, Rabindra Palikonda, Arun Gopalan, Rajendra Bhatt, Conor Haney, Alok Shrestha & Patrick Heck

As part of the NOAA NCDC Climate Data Record (CDR) program, NASA LaRC is currently developing CDRs of cloud and clear-sky radiation properties and shortwave channel reflectance extending from 1978 to the present using data from the Advanced Very High Resolution Radiometer (AVHRR) instrument. The CDR will be consistent with shortwave channel observations and cloud properties derived from MODIS for the Clouds and Earth's Radiant Energy System (CERES) program, though some modifications to these algorithms will be required to operate on the 5-channel and 4-km spatial resolution AVHRR Global Area Coverage (GAC) data. Accurate and stable shortwave channel calibration is essential for producing a robust, long-term analysis of global cloud amount and cloud properties. AVHRR does not have on-board calibration of the visible and near-IR channels so relative calibration techniques must be used. Reliable calibrations are ensured through matching AVHRR with Aqua MODIS using simultaneous nadir overpasses (SNOs) in addition to calibration trends derived from observations of deep convective clouds, deserts, polar ice caps which can also be analyzed prior

to the MODIS era. Differences between MODIS and AVHRR spectral response functions are accounted for using SCIAMACHY spectral band adjustment factors (SBAF). SBAFs for the AVHRR IR channels have also been generated via Aqua MODIS SNOs. AVHRR navigation errors, pixel noise, and bad scan lines have been addressed to ensure that the highest quality input data is used for the CDR.

NASA LaRC cloud and clear-sky radiation property output consists of two categories of fields, 1) fields of sufficient maturity and quality to be used for long-term climate analysis, and 2) new fields that are expected to become "CDR-quality" in future versions. Current CDR-quality datasets consist of 0.63, 0.86, and 1.61 μm channel reflectance, cloud amount, phase, optical depth, and effective particle size, height, temperature, and pressure. Additional fields include land and water surface skin temperature, broadband shortwave albedo and longwave flux, cloud top and base temperature/height/pressure, overshooting cloud top pixel detection, and dataset quality control information.

The CDR generation process has recently begun at NASA LaRC, initially focusing on the NOAA-18 and NOAA-9 AVHRR time series. This presentation describes the methodology used for the CDR, product validation using NASA A-Train observations, comparisons with other available cloud property climatologies, and trends in cloud properties derived from NOAA-9 and -18 processing.

3-17   A Land Product Characterization System for analysis and validation of ABI and VIIRS land data and products
Authors: Kevin Gallo, Calli Jenkerson, Steve Foga, Greg Stensaas & John Dwyer

NOAA and the U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center are collaborating on the development of a Land Product Characterization System (LPCS) that will facilitate the application of multi-satellite and in-situ data for characterization and validation of GOES-R and S-NPP/JPSS land-related products (e.g., Surface Reflectance, Normalized Difference Vegetation Index, and Land Surface Temperature). The system is planned to utilize data and products anticipated to be available from the USGS Landsat-8, ESA Sentinel-2 and -3 series of satellites, and other relatively high and medium resolution sensors, to validate GOES-R Advanced Baseline Imager (ABI) and S-NPP/JPSS Visible Infrared Imager Radiometer Suite (VIIRS) products.

The LPCS includes data inventory, access, and analysis functions that will permit selection of data to be easily identified, retrieved, co-registered, and compared statistically through a single interface. This functionality is evolving through a beta operational phase (2015)

before becoming operational in 2017.

3-18 NOAA Okeanos Ocean Color Operational Product System: A Newly Developed Web-based QA Monitoring Tool for Ocean Color Operational Products

Authors: Banghua Yan, Ian Simpson, Edmond Rodriguez, Derek Van Pelt & Antonio Irving

NOAA CoastWatch Okeanos Ocean Color Operational Product System is a flexible, expandable Linux system capable of processing multiple ocean color products satellite streams, e.g., Sea-viewing Wide Field-of-view Sensor, MEdium Resolution Imaging Spectrometer, Moderate-resolution Imaging Spectroradiometer (MODIS)/Aqua and MODIS/Terra, by using the CoastWatch Automatic Processing Software (CWAPS) including the Multi-Sensor Level (MSL) 12 algorithm. Current Okeanos system has evolved over time from an isolated VMWare environment to a system that incorporates the latest NESDIS Environmental Satellite Processing Center (ESPC) VMware technology that is consistent with the proposed future IT architecture. Since 2006, a series of OC operational products have been created from multiple satellite sensors in the Okeanos system. Current OC products include daily chlorophyll concentration (anomaly), water turbidity, remote sensing reflectance, and chlorophyll frontal products from MODIS/Aqua. The OC products have been widely applied to USA local and state ecosystem research, ecosystem observations, and fisheries managements for coastal and regional forecasting of ocean water quality, phytoplankton concentrations, and primary production. OC products are being extended to Suomi National Polar-orbiting Partnership (S-NPP) and Joint Polar Satellite System (JPSS) Visible/Infrared Imager Radiometer Suite (VIIRS) and other upcoming ocean color sensors in the next few years.
Recent efforts also provide a newly developed comprehensive Quality Assurance (QA) tool for monitoring Okeanos system, OC products processing and quality, associated with the GUI and web-based monitoring tools, referring to http://www.ospo.noaa.gov/Products/ocean/color/index.html. The new QA monitoring tool includes the following advanced features applicable for MODIS/Aqua, NPP/VIIRS, and JPSS/VIIRS OC products. 1) Monitoring system performance, product processing, and product quality in near real time; 2) Monitoring the performance and stability of the system; 3) Monitoring the availability and quality of OC products with time; 4) Detecting anomalous OC products due to low valid pixels, deficient OC algorithm, or mis-matching OC products between the Near Infrared (NIR) from the NASA L2gen OC package and the Near Infrared - Short Wave Infrared (NIR-SWIR) algorithm from the NOAA OC processing package (Courtesy of Menghua Wang); 5) Notifying users of suspicious OC products and system problems.
The Okeanos ocean color operational system in combination with the new QA monitoring tool can more efficiently ensure availability and quality of satellite operational OC products from Okeanos system to the user community. The QA tool also provides much useful information of OC products quality and statistics to the OC user community.

3-19 Operational Wind Products at NOAA/NESDIS

Authors: Hongming Qi, Jaime Daniels, Paul Chang, William Pennoyer, Andrew Bailey, Jeffrey Augenbaum & Yufeng Zhu

This paper summarizes the status of the operational wind products at NOAA/NESDIS. Recent improvements, new additions, processing changes and monitors, future plans of the Atmospheric Motion Vector (AMV) product suite and Scatterometer ocean surface wind product suite will be discussed. The current satellite constellation for operational AMV winds processing includes GOES-13 as the eastern operational geostationary satellite, GOES-15 serving as the western operational geostationary satellite, MODIS from Terra and Aqua and AVHRR from NOAA and MetOp series. The GOES hourly winds replaced 3-hour GOES AMV and have been in operation since May 2014. MetOp-B AVHRR Polar Winds was promoted into the operation in April 2013 and S-NPP VIIRS Polar Winds were successfully transitioned into the operation in May 2014. Besides the operational AMV products, several improvements in NOAA/NESDIS winds processing will be implemented. These improvements include the GOES, MODIS and POES AMV products by using GOES-R/VIIRS algorithms. Updates on the status of these operational AMV products and new wind processing system will be presented. In addition, an overview of the operational ASCAT wind products at NOAA/NESDIS is also presented.

3-20 Ingest and Analysis of NPP-VIIRs data from the NOAA CLASS system: Radiometric Calibration, Bow Tie Correction and Derived Dataset support in the ENVI COTS Software

Authors: Greg Terrie, Patrick Collins, Robert Schafer & Amanda O'Connor

The NPP-VIIRS mission provides crucial data to the meteorological community. Previously, access to imagery stored in a scientific data format such as HDF-5, required some familiarity with the format, finding a reader, or some level of programming to process the data. The ENVI COTS software has added support for VIIRS data delivered from the NOAA CLASS system. This development allowed users to open VIIRS Sensor Data Records (SDRs) in a point and click user interface with no a priori information about the dataset or the file format. Options for opening and processing the data include:
•Automatically opening I-bands, M-bands, Day-Night-Band (DNB), and the Near-Constant-Contrast (NCC) Environmental data record (EDR)

•Automatic calibration to radiance, reflectance,

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brightness temperature or albedo (depending on the data product)

•Optional Swath-to-Grid geocorrection with elimination of bow-tie deletion artifacts for SDRs

•Automatic granule merging to remove swath gap lines for (EDRs)

•Opening derived EDRs such as Aerosol Optical Thickness, Land Surface Temperature, Ocean Color/Chlorophyll, Sea Surface Temperature, Surface Type, and Vegetation Indices

•Scripting of these preceding processes to allow users to work with many NPP-VIIRS scenes

Accessing complex file types in a straightforward manner is the first step towards scientific discovery. The ENVI software makes VIIRS data accessible and usable to virtually anyone who can operate a modern software user interface, thereby opening up VIIRS data to a wider user group supporting broader weather applications in commerce, insurance, agriculture, and disaster response.

3-21 Using VIIRS DNB and OMI NO2 retrievals for constraining NOx Emissions
Author: Brad Pierce

This poster presents results from work being conducted as part of the NASA Air Quality Applied Science Team (AQAST) Oil and Natural Gas (ONG) Tiger Team investigating the use of the composite imagery from the Suomi NPP Visible Infrared Imaging Radiometer Suite (VIIRS) day night band (DNB) to spatially refine Aura Ozone Monitoring Instrument (OMI) NO2 retrievals. Methods for generating fine-scale (4x4km) OMI NO2 products are presented and compared to NO2 columns estimated from insitu airborne measurements obtained during the 2014 FRAPPE/DISCOVER-AQ field campaign.

3-22 Cross-track Infrared Sounder (CrIS) CO2 Information Content and Retrieval Sensitivity Study
Authors: Cong Zhou, Nadia Smith & Hung-Lung Allen Huang

The long-term continuous increase of carbon dioxide (CO2) has drawn significant attention worldwide due to its contribution to climate change. Fast developing and populous countries, such as the US and China, attach great importance to the identification and management of anthropogenic CO2 sources, particularly the burning of fossil fuels. The hyperspectral Atmospheric InfraRed Sounder (AIRS), onboard the polar-orbiting Aqua satellite, has been operational since 2002 and provides a decadal record of the atmospheric thermodynamic state and its chemical composition for climate research. In 2011, the next-generation Cross-track Infrared

Sounder (CrIS) instrument was launched onboard Suomi National Polar-orbiting Partnership platform (Suomi NPP) and promises to extend the AIRS like CO2 record. This work aims to characterize the information content (IC) of CrIS radiance measurements with respect to CO2. We will quantify and evaluate the sensitivity of CrIS IC for CO2 and compare it to other instruments, such as AIRS. In addition, we are to determine how uncertainty in radiance measurements and the atmospheric state (e.g., due to weather fluctuations and imperfection in data processing) potentially impact the retrieval of CO2 climate parameter. The lessons learned here will help to identify current shortcomings in the NOAA Unique CrIS/ATMS Processing System (NUCAPS) CO2 product and guide the design of strategies for improvement of CO2 retrieval from hyperspectral infrared sounders.

3-23 NOAA Soil Moisture Operational Product System (SMOPS): Version 2
Authors: Jicheng Liu, Christopher Hain, Zhengpeng Li, Li Fang, Jifu Yin, Xiwu Zhan & Limin Zhao

Global soil moisture is one of the critical land surface initial conditions for numerical weather, climate, and hydrological predictions. Since it is not practical to provide global maps using ground measurements, land surface soil moisture remote sensing has been a hot research topic in the last several decades. As a result, a number of soil moisture products have been produced from different satellite sensors with different spatial coverage and quality. To make good use of all available soil moisture products, a Soil Moisture Operational Product System (SMOPS) has been developed at National Oceanic and Atmospheric Administration (NOAA) to produce a one-stop shop for all operational soil moisture products from different satellite sensors. To increase the spatial coverage of daily soil moisture retrievals, SMOPS also provides a soil moisture data layer that merges soil moisture retrievals from multiple satellites in addition to the individual soil moisture retrievals from each of the available satellites.

SMOPS has been operationally running at NOAA NESDIS since 2012. In this first version of SMOPS product, soil moisture products from Soil Moisture and Ocean Salinity (SMOS), the Advanced Scatterometer (ASCAT) on EUMETSAT's MetOp-A satellite and WindSat on Coriolis satellite are used to produce the blended product. SMOPS will be upgraded to Version 2 in early 2015 that will improve the SMOPS product in following ways: 1) A new SMOS soil moisture product will be produced using NOAA's own retrieval algorithm to reduce the time latency in using SMOS data; 2) Soil moisture product from ASCAT on MetOp-B satellite will be ingested in the system; and 3) The updated CDF with longer time range will be used to produce the blended product.

As NASA's Soil Moisture Active Passive (SMAP) mission successfully launches, ingesting SMAP soil moisture product into SMOPS will be a major future plan for SMOPS.

3-24 Development of surface reflectance ratios database for VIIRS AOT retrieval over land
Authors: Hai Zhang, Hongqing Liu, Shobha Kondragunta, Istvan Laszlo, Lorraine Remer, Jingfeng Huang & Stephen Superczynski

Surface reflectance ratios of M1/M5, M2/M5, M3/M5, and M11/M5 are crucial to the VIIRS aerosol optical thickness (AOT) retrieval over land for dark pixels. Having better estimates of these ratios can improve AOT retrievals. Current VIIRS aerosol retrieval algorithm uses constant ratios over the whole globe. We present an investigation of the surface reflectance ratios over the global AERONET sites and show that we can improve the AOT retrieval by using more accurate surface reflectance ratios. We investigated two methods to estimate the surface reflectance ratios: the use of AERONET AOT and clear sky method. We demonstrated that both methods improve VIIRS AOT retrievals over dark pixels. Especially, the clear sky method does not depend on the AERONET AOT and therefore we can apply this method to the regions without ground measurements.

In addition, we also investigated the possibility of the AOT retrieval over bright surface using the surface reflectance ratios. We derived surface reflectance ratios of M1/M5, M2/M5, and M3/M5 over AERONET sites in North Africa and Arabian Peninsula. We demonstrated that these ratios can be applied in the algorithm similar to the dark pixel algorithm and retrieve AOT. We show that the retrieved VIIRS AOT over these regions has similar accuracy as MODIS deep blue AOT.

3-25 CSPP GEO GVAR data conversion for use in GOES-R algorithms
Authors: Scott Mindock, Jessica Braun & Graeme Martin

The CSPP GEO project at University of Wisconsin, Madison has developed software to convert raw GVAR data into form usable for GOES-R algorithm input. The CSPP GEO GVAR and CSPP GEO GEOCAT couple to produce GOES-R Cloud Products in a Direct Broadcast environment.

The CSPP GEO GVAR software package assembles McIDAS format areas without the use of McIDAS. These files are also remapped to provide temporal stability desired by GOES-R algorithms. Quick look image generation is supported to provide a fast method for quality insurance. The poster details the interfaces and processing steps required to provide reliably packaged data for GOES-R Cloud Products in a Direct Broadcast environment.

3-26 Comparison of the NOAA NDE VIIRS and the NASA C6 MODIS Cloud Masks Over the Entire EOS AQUA Record
Authors: Andrew K. Heidinger, Steven A. Ackerman, Denis Botambekov & Richard Frey

NOAA is implementing a cloud mask for the Visible Infrared Imaging Radiometer Suite (VIIRS) within the S-NPP Data Exploitation (NDE) system. One of the most established and well-used cloud masks comes from the NASA Moderate-Resolution Imaging Spectroradiometer (MODIS). Because MODIS provides all of the spectral bands used by the VIIRS NDE mask, it provides a convenient platform to test the performance of the NDE cloud mask over many years. This poster will compare the VIIRS NDE mask to the MODIS C6 mask over then entire MODIS/AQUA record (2002-2014). The impact of MODIS channels missing on VIIRS will be discussed and the long-term stability of the NDE VIIRS mask will be shown.

3-27 Better Weather Forecast using NOAA Satellite Data by National Meteorological Institute (INMET)
Authors: Alaor Moacyr Dall'Antonia Jr, Wagner de Aragão Bezerra & Kleber Renato da Paixão Ataide

NOAA satellites are very important for the weather forecast and to monitorate the severe weather conditions in Brazil. The INMET has direct readout stations for Geostationary and Polar orbit satellites at Brasilia. INMET operation employs routinely the NOAA satellite data as the basic images and also products and specific channels combinations are generated. INMET disseminate the images and products trough the web page and intranet. This poster will present the basic products generated in INMET as well the importance for our operation of the NOAA satellites data to better weather forecast. The new NOAA satellite generation and the GeonetCast are some examples of the news tools that will be
used operationally in INMET (a new X band equipment for the polar orbit satellites is operating now) in the near future, the preparation and activities related to this will be also be described in the poster.

3-28 Recent additions to the Community Satellite Processing Package (CSPP) from algorithm developers at NOAA
Authors: James E. Davies, Aronne Merrelli, Kathy Strabala, Liam Gumley, Allen Huang, Christopher Grassotti, Xiwu Zhan, Christopher Barnet, Thomas King, John D. Stroup & Yury Kihai

The Community Satellite Processing Package (CSPP) supports the Direct Broadcast (DB) meteorological and environmental satellite community through the packaging and distribution of open source science software. We have recently added three NOAA-developed algorithms to our environmental data record

(EDR) software suite, namely, Microwave Integrated Retrieval System (MIRS), NOAA Unique CrIS/ATMS Processing System (NUCAPS) and, most recently, Advanced Clear Sky Processor for Oceans (ACSPO). These packages are pre-compiled and statically linked; they are ready to run under most modern Linux distributions within minutes of download. Their command line interfaces are simple to use, either stand-alone or integrated into a near-real-time satellite data processing pipeline. This poster describes system and data requirements for running these packages, how to obtain them, and outlines the major EDR product fields from each that can benefit the DB community.

3-29   Night Light Pollution in Large Coastal Urban Areas Through Nighttime DMSP Satellite Images

Authors: Carlos Cotlier, Cristina Pacino, Benito Vicioso, Laura Barparda, Gabriel Cotlier, Diego López & Dardo Delorenzi

Marine light pollution could be defined as a "degradation of photic habitat by artificial light" (Verheijhen, 1985), disturbing natural organisms behavior when are exposed on wrong place, time and intensity (Marine Pollution Bulletin, 2010).

At least 3351 cities worldwide are over the shoreline spreading light over beaches and seaboard, 18 of the 20 largest cities from Asia are located on the coast, shoreline or river deltas (Marine Pollution Bulletin, 2010).

Night-time Satellite data have been use on several research subjects related to population and energy consumption (Elvidge et al, 1997), urban area mapping (Imhoff et al, 1997), estimation of worldwide flared gas volumes (Elvidge et al, 2007) and economic development (Sutton et al, 2007), forest fire monitoring (Badarinath et al, 2011) and plankton artificial light influence (Kazushi et al, 1997).

In this first research stage the preliminary focus is on marine/coastal environments of six cities selected for their distinct urban characteristics and geographic locations: Naples (Italy), Athens (Greece), New York (USA), Barcelona (Spain), Buenos Aires (Argentina), Istambul (Turkey).

A methodology to model "night light pollution" is presented combining satellite imagery with geographic information systems (GIS) and vector shape data, such as bathymetry, coastal boundaries and city limits and different maps with Satellite images were used and statistical analysis were performed.

Satellite data products used in this research were produced by the NOAA agency, from DMSP-OLS (Defense Meteorological Satellite Program – Operational Line Scanner) instrument from Department of Defense (DoD, USA) and Air Force Space and Missile Systems Center (SMC).

As part of some conclusions:

1. Buenos Aires city has the smallest average luminance with an important light pollution affected area. Could be awarded to geography on which the city is located and with a river (freshwater and very low depth) in its waterfront instead open sea.

2. Istanbul followed by Athens and New York/New Jersey have the highest average luminance but emphasizing that New York/New Jersey area is extensive, nearly 4 times bigger than Buenos Aires area (second in illuminated area size).

3. To complement data and available information preliminary analysis, following subjects will be analyzed.

4. Impacts of light pollution on coastal living organism's behavior, analysis could provide new considerations for urban coastal centers expansion and planning.

5. More efficient illumination systems possible use that could reduce light ocean pollution phenomena.

3-30   El Salvador Natural Phenomena Monitoring Stations with Satellite Communication

Author: Edwin Escobar

Satellite communications in El Salvador is used in many communication systems to facilitate automatic monitoring and recording measurements of valuable environmental information and sending alerts and alarms to the control center in order to keep safe the population against destructive climatic events.

This country has 110 Natural Phenomena Monitoring Stations with Satellite Communication.

3-31   ATMS/AMSU Snowfall Rates during the 2014-15 Winter Season

Authors: Huan Meng, Cezar Kongoli, Jun Dong, Ralph Ferraro & Bradley Zavodsky

The AMSU Snowfall Rate (SFR) product has been in operation at NESDIS since 2012. The ATMS SFR algorithm was developed based on the AMSU SFR but with several key advancements. The improvement made in the development of the ATMS SFR was also applied to the AMSU algorithm so the product benefits from the advanced algorithm across sensors. Currently, there are five satellites that carry one of the two sensors: S-NPP, NOAA-18/-19 and Metop-A/-B. The combined satellites provide up to ten SFR estimates a day at any location over land in mid-latitudes. The 2014-2015 winter is the first snow season when both ATMS and AMSU SFR products are available for applications. Through collaboration among NASA/SPoRT, NESDIS, University of Maryland/CICS, and several NWS Weather Forecast Offices (WFOs), the SFR product is evaluated at the WFOs this winter for its usefulness in snowfall forecast operation. To meet the latency requirement for weather forecast, the Direct Broadcast (DB) data from University of Wisconsin and University of Alaska are used to generate the SFR product. This leads to a latency of about 30 minutes. This poster will present the performance of the ATMS/AMSU SFR product during the 2014-2015 winter season and some case studies.

3-32   Improvement of cloud detection with COMS in the day-night transition area

Authors: Byung-il Lee, Hyungmin Park & Sung-Rae Chung

An analysis of the performance in the detection of cloud through COMS (Communication, Ocean and Meteorological Satellite) shows that fog and low-level clouds are often undetected in the day-night transition areas. In this study, we introduce 'normalized reflectance test' and 'brightness temperature difference (BTD 3.7-11) test' into the cloud detection procedure for reducing this discontinuity. Compared to the operational cloud detection, the new approaches lead to improve detection of low-level clouds including sea fog in the COMS observational area. This study has been done in preparation for Geo-KOMPSAT-2A satellite which will be followed on COMS.

3-33 Selenographic Coordinate Mapping of Lunar Observations by GOES Imager

Authors: Xi Shao, Xiangqian Wu & Fangfang Yu

Radiometric stability of the lunar surface, its lack of atmosphere and smooth reflectance spectrum makes the moon surface an ideal target for calibrating satellite-based multi-band imagers. Lunar calibration for solar bands has been an important part of trending the instrument radiometric performance. The lunar disk-equivalent irradiance has been used to trend the on-orbit degradation of the GOES imager and its performance is largely affected by the uncertainties embedded in the lunar irradiance model in characterizing its dependence on lunar phase and libration, as well as the satellite measurements. On the other hand, the lunar view by GOES imager provides opportunity to perform radiometric calibration of GOES imager using lunar radiances of selected locations on the Moon. In order to do so, the GOES lunar observations need to be mapped onto selenographic coordinate, i.e. latitude and longitude in moon-centered coordinate. In this paper, algorithms and procedures are developed to map GOES lunar images onto selenographic coordinate. Each individual lunar observation is corrected with progressive shift in east-west scan direction, oversampling factor and distortion of lunar image to result in a disk-shaped moon image. Both controlling point and landmark matching are applied to determine rotation angles and three consecutive rotations are performed to map lunar observation onto selenographic coordinates. Lunar observations of GOES-12 are processed and regions of interest (ROIs) are identified. Solar zenith angle and viewer zenith angle-dependence of lunar radiances at ROIs are analyzed. It is found that lunar radiance depends strongly on Sun-Moon-Satellite geometry and knowledge of BRDF of lunar surface can enable trending of radiometric performance of GOES imager with lunar radiance.

3-34 Profiling Deep Cloud Systems with Satellite Imager Data and Potential Applications

Authors: William L. Smith Jr., Cecilia Fleeger, Douglas Spangenberg, Patrick Minnis & Mandana Khaiyer

Accurate characterizations of deep ice over water clouds associated with convection and mid-latitude storm systems are needed due to their association with hazardous weather and precipitation, and because of their significant contribution to regional cloud water budgets. Due to their complexity and thickness, these clouds are challenging to resolve with any single observing system, thus synergistic approaches are required. In this study, a daytime cloud water content profiling technique has been developed for application to cloud retrievals that employ visible, near-infrared, and infrared radiances from passive satellite imagers. Ice and liquid water content (IWC and LWC) profiles are derived by using the imager-based retrievals of cloud optical depth, effective radius, cloud top height and geometric thickness to constrain climatological information on cloud vertical structure obtained from active sensor data and from cloud model analyses. Retrievals of the super-cooled liquid water content embedded within overlapping clouds are one outcome of this approach. These are used to estimate the icing threat to aircraft using guidance from an airfoil modeling study and are verified using icing intensity reports from pilots (PIREPS). Compared to PIREPS, the satellite icing detection and intensity accuracies are found to be about 90% and 70%, respectively. The embedded liquid water path (LWP) estimates are also found to agree well with estimates from ground-based microwave radiometer data over a wide range of overlapping cloud conditions. In the upper troposphere, mean differences between the imager-based IWC retrievals with those from CloudSat and Calipso are found to be less than 30%. This level of closure in the cloud water budget of cold optically thick clouds can only be achieved by correcting for errors in the traditional imager cloud water path retrievals that arise from the simplifying but poor assumption that these clouds are single-phase and vertically homogeneous. When applied to geostationary satellite data, the profiling method provides a real-time characterization of clouds in 4-D. The method also has the potential to improve cloud climatologies since it resolves both the liquid and ice water content simultaneously in deep cloud systems and because the method can be applied over land and ocean. This research could improve the utility of satellite imager data for quantitatively diagnosing and predicting clouds and their effects in weather and climate applications.

3-35 Use of VIIRS RSBAutoCal in Calibration Monitoring and Direct Readout Support

Authors: Slawomir Blonski & Changyong Cao

An automated procedure, called RSBAutoCal, has been implemented in the operational IDPS (Interface Data Processing Segment) software to provide updates of the radiometric calibration coefficients for the VIIRS (Visible Infrared Imaging Radiometer Suite) reflective solar bands. RSBAutoCal is also included in the ADL (Algorithm Development Library) software that can be executed outside of the IDPS system. While

RSBAutoCal executed in IDPS is still undergoing temporal filter optimization, ADL has enabled us to use RSBAutoCal to derive the calibration coefficients without any filtering. The coefficients are generated from onboard solar diffuser measurements that are conducted once per orbit, but data from multiple orbits are aggregated before a new set of the coefficients is created and subsequently implemented in the operational IDPS processing. RSBAutoCal executed separately without the temporal filter allows analysis of the calibration coefficients calculated for each orbit. We have compared time series of these coefficients with those generated offline and applied in the operational VIIRS SDR (Sensor Data Record) production. SDR products based on the RSBAutoCal-derived calibration were generated for the Saharan pseudo-invariant sites and for the simultaneous nadir observations to detect calibration anomalies and to improve its accuracy. Calibration coefficients derived by us using RSBAutoCal for the period preceding its activation in IDPS can be provided to the Direct Readout users for consistent processing of their VIIRS data products.

3-36

3-37 GOES-R Atmospheric Motion Vectors Future Use in NCEP GFS

Authors: Sharon Nebuda, Jim Jung, Dave Santek, Jaime Daniels & Wayne Bresky

Atmospheric Motion Vectors (AMVs) provide vital information of wind information for data assimilation systems by tracking features observed by satellites. The temporal and spatial coverage of AMV data from operational satellites has been increasing with significant improvement expected by the GOES-R Advanced Baseline Imager (ABI). To allow the most successful, timely use of these GOES-R AMVs, proxy data generated from the Spinning Enhanced Visible and Infrared Imager (SEVIRI) and the new Nested Tracking Algorithm have been assimilated in the NCEP GFS to investigate appropriate quality control methods and observation error settings. Results from these assimilation experiments will be presented.

3-38 GOES-East satellite images processing in Uruguay and future perspectives

Authors: Rodrigo Alonso Suárez, Ricardo Siri, Nicolás Wainstein & Gonzalo Abal

Satellite images provide invaluable information on the state of the Earth's atmosphere. The derived satellite products have a variety of applications in fields such as meteorology, agriculture, energy assessment, among others. However, the processing of GOES satellite information in Uruguay is still in its initial stages. Historically, the images were used only for visual assistance to the meteorological forecast. A first product for solar resource assessment, based on GOES-East visible channel digital counts, was locally implemented four years ago at the national University. Since then,

GOES satellite image processing has been gradually improved. Currently, satellite counts are being calibrated and converted into physical magnitudes, such as reflectance factor for the visible channel and brightness temperature for the infrared channels. This information allows us to work on products with a higher level of complexity.

Our local GOES-East images database has been constructed and is maintained via NOAA's CLASS service. We have downloaded images from January 2000 to date, for a spatial window that includes the whole territory of Uruguay, the southern part of Brazil and the area of Buenos Aires' province. The calibration of the images is done following the recommendations in NOAA/STAR's and NOAA/OSPO's websites. The resulting solar assessment product is now based on the reflectance factor instead of the visible channel's counts. Its estimates have been used for solar resource characterization and to generate solar data for ad-hoc sites both for energy and agriculture applications. We are currently working in a cloud index and a cloud classification products.

In spite of these useful applications, Uruguay did not host an operational GOES-East receiver in its territory. In a joint project supported by the national telecommunication company (ANTEL), efforts are now underway to install such a receiver. Images will be obtained and served in real-time for the national meteorological institute (INUMET), the national University and other public institutions. Access to real time satellite information will allow local research groups to develop operational forecasting tools such as nowcasting or to include the information in numerical weather prediction models. This experience is intended to be a first step in preparation for the next generation of NOAA's geostationary satellites which will have a much higher data rate.

3-39 S-NPP Operational Products at NOAA/NESDIS/OSPO

Authors: Shuang Qiu & Antonio Irving Curtis Alexander & Stan Benjamin

The Office of Satellite and Product Operations (OSPO) provides timely access to atmospheric, oceanic, and land surface satellite data from the Suomi-National Polar-orbiting Partnership (S-NPP). OSPO 24x7 operations support ensures that mission critical data are delivered to end users on time and maintaining high quality. In addition to provide Sensor Data Records, Temperature Data Records, and Environmental Data Records from the S-NPP/Joint Polar Satellite System (JPSS) ground segment in the data format and map projection required by the user, OSPO also generates NOAA – developed products algorithms, which provide mission continuity for NOAA's Polar-orbiting Operational Environmental Satellite (POES) series of satellites. This

paper describes these S-NPP operational products, and provides an overview on how to access these products.

3-40 JPSS SMD Data Capture and Processing & Distribution Hub Systems
Authors: Harek Gamst & Kenneth Pettersen

Kongsberg Spacetec AS (KSPT) has delivered the ground station SMD data receivers as well as the SMD data Hubs for the JPSS program under a contract with Raytheon.

The SMD data handling has been designed to provide:
• Reliable SMD data capture and delivery to the SMD customers
• Data consolidation, time ordering and duplicates removal
• Extensive reporting of data quality, statistics and timeliness
• Multi mission support – for NOAA JPSS and cooperative missions
• Data driven automated operations
• Standardization and customer configurability

The MEOS Capture HRDFEP is used on the ground stations to capture data from all JPSS missions. Two independent channels support data capture from one or two concurrent spacecraft. Data is formatted to EVCDUs and automatically pushed to the JPSS SMD Hub for further processing and distribution. The HRDFEP provides high rate SMD data transfers via the Space Link Extension (SLE) protocol, using Provider Initiated Binding to the JPSS SMD Hub, supporting both RAF and RCF services.

The HRDFEP performs local processing of VCDUs into Application Packets and uses both data types to generate extensive data reports. These reports are used to support system wide data accounting status.

The JPSS SMD Hub receives data from multiple ground stations concurrently, while forwarding the same data to multiple other Hubs. It performs consolidation of successive data segments, removes overlapping data, fills data gaps and generates time ordered data sets. The Hub generates and distributes EAP files to up to 15 customers concurrently. The distribution is defined by individual configurations per customer, supporting individual customer needs.

The Hub generates SMD data reception and delivery reports to support system wide data accounting, as well as data latency monitoring.

While the HRDFEP runs in scheduled or data driven mode, the Hub runs in data driven mode only. This makes for a robust and reliable system solution with minimized need for operators' attention.

3-41 Integrated Satellite Network of the Direccion Meteorologica de Chile (DMC): Description, Available Products and Future Plans
Author: Juan Pizarro

Chile's Met Service (DMC) operates an Analysis and Forecasting System using meteorological data from AWS at ground level and at upper altitude, within and outside Chile. The outputs are numerical models, regional model MM5 (Mesoscale Model version 5) and WRF. We use the following satellite data: NOAA (HRPT), GOES (GVAR), and TERRA-AQUA (MODIS). All satellite data is processed through Chile's Integrated Satellite Network (Red Integrada Satelital, RIS) and then disseminated to the entire country. RIS receives, processes, visualizes and integrates satellite and in

situ data from sources such as WAFS and GTS. RIS constitutes the basis for the country's weather prediction. RIS has 9 antennas for direct readout (4 GOES-13 antennas, 3 NOAA polar-satellite antennas, and 2 TERRA-AQUA antennas). The antennas are installed throughout the country, including Antarctica and Easter Island. RIS uses water vapor, visible and infrared channels in order to generate products on temperatures, vegetation index, wildfires and others, available at: http://www.meteochile.gob.cl/imagenes_satelitales.php DMC is currently working on upgrading RIS in order to be able to receive and process GOES-R and NPP/JPSS data.

3-42 Status and future plan of development of meteorological products through Korean Geo-KOMPSAT-2A satellite
Authors: Sung-Rae Chung, Byung-il Lee, Tae-Myung Kim, Eun-Bin Park & Jae-Gwang Won

The next Korean geostationary meteorological satellite Geo-KOMPSAT-2A (GK-2A), which has been developed since 2013, has an advanced meteorological imager (AMI). GK-2A/AMI, Himawari-8/AHI-like sensor, will provide high resolution data in time and space. KMA also has started to develop algorithms of fifty-two meteorological products for applying nowcasting, numerical weather prediction, climate and so on. These products consist of four groups, such as scene analysis and surface information, cloud and precipitation, aerosol and radiation, and atmospheric information. KMA works in close collaboration with academia and research institute on the algorithm development. In this paper, the status and future plan of the GK-2A meteorological products development are introduced.

3-43 Not-So Silent Night: Suomi NPP's Day/Night Band Makes Waves as a Disruptive Technology to Characterization of the Nocturnal Environment
Authors: Steven Miller, William Straka III, Cindy Combs, Curtis Seaman & Jia Yue

Daytime measurements of reflected sunlight at visible-light wavelengths have been a mainstay of Earth-viewing

radiometers, dating back to the first 'vidicon' cameras of the TIROS series. At night, satellite observing systems traditionally have been limited to measures of thermal infrared emission, which hold relatively poor information content for many important weather and climate parameters owing to lack of sensitivity. These deficiencies have in turn limited our ability to characterize the diurnal behavior of parameters (e.g., clouds) relevant to improved monitoring, understanding and modeling of weather and climate processes. The challenges are particularly severe at high latitudes, where the dearth of sunlight in the polar winter renders conventional visible-band measurements obsolete for extended periods of time.

In fact, the veil of night harbors a symphony of visible light emissions from a vast array of natural and anthropogenic sources. Detecting this light requires specialized technology in order to achieve sensitivity to signals residing several orders of magnitude lower than day-lit scenes. Such refined technology has in fact existed for many decades on the U.S. Department of Defense satellite constellation, but historically limited access of those data combined with the inherent limitations of its 1960-vintage sensor design has precluded the full exploitation of nocturnal light. The Suomi National Polar-orbiting Partnership (S-NPP) satellite has forever changed this landscape. Its Visible/Infrared Imaging Radiometer Suite (VIIRS), which includes a Day/Night Band (DNB) radiometer offering the first calibrated, highly advanced measurements of nocturnal visible/near-infrared light, represents a truly disruptive technology vis-à-vis the conventional emissive bands.

Here, we review through striking illustrative examples the paradigm shift in nocturnal applications enabled by the S-NPP VIIRS/DNB. Via a combination of terrestrial and extraterrestrial light sources, we show that visible observations are indeed always available. These novel measurements extend many daytime-relegated applications, enable a suite of new operational applications, and illuminate heretofore unexplored and unimagined interdisciplinary research pathways. Even as the DNB expands our current world-view of what is possible at night, it provides key insight for the optimized design of next-generation low light visible sensors whose time has perhaps finally come.

3-44 Early Inter-sensor comparison result of Himawari-8 Advanced Baseline Imager with the Visible Infrared Imaging Radiometer Suite
Authors: Mike Chu, Xiangqian Wu & Fangfang Yu

The Advanced Himawari Imager (AHI) on board the Himawari-8 geostationary satellite launched on October 7, 2014 by the Japanese Metrological Agency (JMA) is the first of the many next-generational meteorological and weather observing sensors to come. We carry out an investigation of the inter-sensor comparison of AHI with the Visible Infrared Imaging Radiometer Suite (VIIRS) on board Suomi-NPP satellite which is polar-orbiting. We present results from two approaches of comparison, one using collocated earth scenes via ray-matching method and the other using deep convective clouds (DCC) identified by the AHI 10.35 μm channel, of radiance or brightness temperature between the matching channels of the two sensors. For both cases the spatial domain of interest is kept within 15° latitude and 30 longitude of AHI sub-satellite point at 0° latitude and 140° longitude. The result shows AHI to be stable in the early mission, and in addition, that the inter-comparison between latest high-performance geostationary and polar-orbiting sensors can generate a wealth of high quality matches on a daily basis. As AHI is a near-twin built of the GOES-R Advanced Baseline Imager (ABI) to be launched in 2016, the study is a valuable contributing preparation by the GOES-R ABI Calibration Working Group going forward.

3-45 Monitoring of Forest Fire Hotspots
Author: Jesús Romero

The detection of forest fires in Mexico utilizing the Hazard Mapping System (HMS) and the Servicio Meteorologico Nacional's (SMN) McIDAS system, in cooperation with the Satellite Analysis Branch (SAB) of NOAA. The data sources used are AQUA and TERRA, NASA's MODIS, as well as NOAA-15, 18, and 19 and METOP AVHRR data.

Additionally, we utilized the following algorithms to prepare the satellite data for automatic detection of forest fire hot spots.

The Running Wildfire Automated Biomass Algorithm (WF-ABBA) was developed by Dr. Elaine Prins of the University of Wisconsin. The algorithm detects hot spots every 30 minutes and is automated to run 24 hours a day 365 days a year. The threshold temperature of a pixel is 750 K, with the minimum detectable area being approximately .002 km2.

The Fire Identification and Monitoring Algorithm (FIMMA) was developed by Dr. Ivan Csiszar of the University of Maryland. This is an analysis of observations has a superficial temperature gradient based on the AVHRR sensor of NOAA-15, 18 and 19. The first step is to re-navigate the images in order position the hot spots in an suitable form. The resolution of one pixel is 1.1km2.

The AEM forms part of the National Alert System for forest fires. This system supplies information for the decision support of the programs and projects to manage and control fires that are present in Mexico. Also, AEM collaborates with the National Center for Disaster Prevention to provide decision support for other types disasters and natural phenomenon.

3-46 GEONETCast Américas, Costa Rica

Author: Rodolfo Sánchez

This poster highlights the products that Costa Rica provides to the GEONETCast Americas (GNC-A) system. Costa Rica has four GNC-A receive stations in different parts of the country. IMN, Costa Rica's Met Service based in San Jose, prepares various satellite products such as daily output from the WRF model for weather prediction, the prediction from the Central American Flashflood Guidance model, and data from atmospheric radiosondes. IMN will soon broadcast Bufr products.

The poster illustrates the GNC-A satellite broadcast footprint and the location of the four GNC-A receive stations in Costa Rica, as well as a sample of products currently broadcast through GNC-A. The poster also shows the basic architecture of the GNC-A system, including data providers, uplink and reception by the users.

3-47 Verification of Soil moisture Estimations from AMSR-E and AMSR-2
Author: Gloria Cristina Pujol

Soil moisture is one of the most important hydro meteorological variables that characterizes the conditions of the soil and may be derived from passive microwave radiometer observations, such as from AMSR-E and SHIZUKU GCOM-W1-AMSR-2 on board the satellites AQUA (NASA) and SHIZUKU (JAXA), respectively. Twice a day, AMSR-E and AMSR-2 offer instantaneous soil moisture retrievals at the top 1.5 cm layer with 0.25 and 0.10 degrees spatial resolution, respectively. Soil moisture is obtained by using the Land Parameter Retrieval Model (LPRM), the Standard NASA Algorithm and the Polarization Ratio Variation Index (PRVI) for AMSRE, and Fuji algorithm 2009 algorithm is applied to AMSR2.

The aim of this study is to explore the usefulness of AMSR-E and AMSR-2 daily soil moisture estimations for large areas. Soil moisture estimations were compared against field measurements carried out by the Argentinean Space Agency (CONAE), and rainfall retrievals derived from Tropical Rainfall Measuring Mission (TRMM), under wet and dry conditions both in 2014 and 2008. The results of these comparisons for the Argentine Pampas will be shown.

3-48 VIIRS Active Fires algorithm integration in NPP Data Exploitation (NDE) environment: research to operations
Authors: Marina Tsidulko, Walter Wolf, Ivan Csiszar, Louis Giglio & Wilfrid Schroeder

The Suomi National Polar-orbiting Partnership represents a critical first step in building the next-generation JPSS satellite system. It was launched in October 2011 and carries the same suite of sensors that will be on board of JPSS satellites first of which (J1) is planned to be launched in 2017. The VIIRS Active Fire algorithm (AF) has been developed at the University of Maryland (UMD) and is based on MODIS active fire detection product heritage. The current version of the

VIIRS Active Fire algorithm runs over land and produces a list of fire detections in a sparse array format. The algorithm is run on S-NPP VIIRS data within the IDPS. The enhanced version of the algorithm provides additional outputs including the Fire Radiative Power (FRP) of each fire pixel and a new attribute to describe land for each pixel (Fire Mask). It also provides global coverage including water. This enhanced version of the AF algorithm is currently planned to be implemented in the NDE development environment with following transition to operations to OSPO. Initially it will run on S-NPP data and is planned to create the J1 product in the future. The presentation describes in details transition of the original UMD enhanced code into STAR development environment and implementation in NDE pre-operational environment. Data flows and formats are described. The final product is generated in NetCDF-4 format and will to be available for users through the OSPO distribution system.

3-49 Quality Control of Requirement Documentation Using SASQUATCH (Simplified And Streamlined QUality Assurance Through Coding Help) Perl Script
Authors: Haidao Lin, Steve Weygandt, Ming Hu, Curtis Alexander & Stan Benjamin

SASQUATCH (Simplified And Streamlined QUality Assurance Through Coding Help) is a Perl script developed by NOAA/STAR Algorithm Integration Team (AIT) to facilitate the algorithm review process. The script converts an existing spreadsheet of requirements information into formatted documentation and slide presentations. Designed to ensure quality control and content consistency between multiple document types, changes are made in one place (the spreadsheet). We discuss the current capabilities of SASQUATCH as well as future enhancements, including the ability to read in existing requirements documents or presentation outlines and analyze differences between documents. Using alternative tools, changes can be tracked, and modifications documented to ensure quality assurance.

3-50 Using Satellite Information in Energy Applications in Costa Rica
Authors: Evelyn Quiros & N. Alvarado

Recent Work: As in many other countries, the demand for solar energy in Costa Rica has increased. Costa Rica has been measuring Global Horizontal Solar Radiation (GNI) for over 20 years, but this measurement has been the low-quality. With our dense network of radiometric measurements, we set out to identify regions with adequate levels of average daily sunlight to optimally place solar engineering applications. When the solar map was prepared (by ICE) limitations were identified in extrapolating the measurements to remote areas that were at different elevations and climate environments where no measurements existed. The approach taken to address the limitations relies on using a satellite-based solar resource model validated with high-quality ground

data. The use of high resolution (visible channel) data from GOES has been essential in extrapolating and generating a time series of irradiation data for any site in the territory. A climatological characterization of the solar resource is now possible with the production of solar potential maps. An hourly time resolution allows the proper modelling of the different solar radiation components relevant to solar energy applications. This represents a significant improvement in the amount and quality of solar information that is available for solar engineering applications in Costa Rica. This methodology is in process to use in Costa Rica now, and will be shared and made available to the Central American region through University of Costa Rica (UCR) for its development in next years. We look forward to utilizing the increased spatial and spectral resolution of GOES-R

Key words: quality control, solar data, GOES, irradiance, radiation, solar energy, solar potential maps, Central America

Future Work: Comparison of results of Geostationary Lightning Mapper (GLM) from GOES-R and Lightning net of LS7001 LF sensors from Costa Rica: Costa Rica looks forward to the benefits of the new Geostationary Lightning Mapper on GOES-R. The Costa Rican Electricity Institute has a high resolution network with 7 LS7001 LF sensors. After the launch of GOES-R we plan to compare the GLM data with that from our local sensors. Some differences are anticipated because the resolution will be different, but in areal density of discharges and tendencies we expect to obtain a good correlation. These results will be shared with the rest of Central America to prepare them in the optimal use of the GLM data in the near future. These efforts will help ensure safe transport and adequate supply of the electricity for the region.

3-51   Validation of Suomi NPP-VIIRS IST using IceBridge Measurements
Authors: Mark Tschudi, Richard Dworak, Yinghui Liu & Jeffrey Key
Ice Surface Temperature is a key indicator of the onset and duration of the Arctic and Antarctic sea ice melt season. The Suomi NPP VIIRS Ice Surface Temperature (IST) product is being inter-compared with other surface temperature products and validated using measurements acquired during NASA's Operation IceBridge, which commenced in 2009. IceBridge is ongoing, utilizing a P-3 aircraft carrying several instruments to measure sea ice and ice sheet characteristics over the Arctic during the spring and the Antarctic in the fall. The aircraft deploys a Heitronics, Inc. KT-19, which is a downward pointing IR pyrometer that measures the IST.

We present comparisons between the VIIRS IST product, other satellite-based surface temperature products, including NOAA's NCEP product, and coincident IceBridge KT-19 measurements. Differences

between these products are evaluated and discussed.

3-52   Alaska Direct Broadcast
Authors: Gwendolyn Bryson , Jay Cable, Jeremiah Dabney, Carl Dierking, Tom Heinrichs, Scott Macfarlane, Eric Stevens & Greg Wirth
The Alaska Direct Broadcast project was initiated as part of the National Oceanic and Atmospheric Administration (NOAA) Sandy Supplemental to enhance the delivery of imagery and products derived from polar orbiting satellite data to the Alaska National Weather Service (NWS). The project is a collaboration among University of Alaska Fairbanks (UAF) Geographic Information Network of Alaska (GINA), National Environmental Satellite, Data, and Information Service (NESDIS), and National Weather Service (NWS). The project will promote best-effort, research products to 24/7 operational products by installing a new 3.0 m antenna and near-real time (NRT) processing and delivery capabilities at the NESDIS Fairbanks Command & Data Acquisition Station (FCDAS) in Fairbanks, Alaska. The project will deliver satellite imagery to the NWS that mitigates the risk of a data gap between Suomi National Polar-orbiting Partnership (SNPP) and Joint Polar Satellite System-1 (JPSS-1); including MODIS, POES AVHRR3, DMSP/OLS, and MetOP AVHRR3 products. In addition, redundant satellite acquisition and processing capabilities will be provided by a combination of new and existing assets at the UAF campus, thereby increasing acquisition and processing capacity and ensuring minimal interruptions to service.

3-53   Arctic Weather Every 10 Minutes: Design and Operation of ABI for PCW
Authors: Paul Griffith & Susan Wirth
This presentation will discuss the key weather observation performance objectives for the Canadian Polar Communication and Weather (PCW) mission and how they drive the design and operation of a PCW imager.

The decreasing ice in the Arctic is leading to more personnel, ships, and operations, resulting in a greater need for more accurate, timely weather predictions. The US, Japanese, Korean, and European meteorological agencies are all upgrading their geostationary weather imagers to provide much more frequent Full Disk Earth images (every 5 to 10 minutes). Arctic weather observation, however, is still limited to a few passes a day from low Earth orbit (LEO) satellites, many of which are well beyond their intended operational life.

The Canadian Polar Communication and Weather (PCW) mission concept is to provide Arctic weather observations with the same temporal fidelity and spectral resolution as equatorial and mid-latitude weather and similar spatial resolution. This presentation will discuss how the key performance objectives drive the design and operation of a PCW imager. Key mission decisions include number of satellites, orbit (LEO vs. HEO; Molniya, TAP, Tundra), coverage, image collection

interval, types of images (Full Disk, storm watch, etc.), spectral bands, spatial resolution, etc.

Exelis' Advanced Baseline Imager (ABI) will fly on GOES-R East, GOES-R West, Himawari (Japan), and GEO-KOMPSAT-2A (Korea), providing these missions the additional capability for interleaved mesoscales delivering storm observations every 30 to 60 seconds. ABI's operational flexibility also makes it an ideal solution for the PCW mission.

3-54   Monitoring Meteorological Data
Author: Jorge Chira

SENAMHI has 198 automatic hydro-meteorological stations. All using the NOAA DCS system. 162 (82%) of the stations are in remote, difficult to access locations. SENAMHI has established the Centro de Monitoreo to monitor the operational status of the stations and to verify the quality of the data coming from the stations.

3-55   Satellite Images: Tools for an Efficient and Timely Early Alert System
Author: Francisco Argeñal

NOAA Satellite images are important tools used by CENAOS along with other data types for the forecasting and monitoring of extreme environmental events in Honduras, such as tropical cyclones, ocean surface temperatures, and droughts.

3-56   Investments and Preparations for GOES-R in Costa Rica
Author: Eladio Solano

Costa Rica's Instituto Meteorologico Nacional (IMN, the country's Met Service) has been acquiring equipment in order to be able to receive the new products from GOES-R. The poster shows the activities carried out up until 2014 in terms of infrastructure and investments, as well as planned activities for 2015 and 2016. IMN intends to be ready to receive and use GOES-R satellite data in order to benefit Costa Rican society.

3-57   OMPS Limb Profiler Aerosol Extinction Algorithm Development
Authors: Robert Loughman, Ernest Nyaku, P.K. Bhartia & Nick Gorkavyi

This poster describes recent updates to the OMPS Limb Profiler (LP) aerosol extinction algorithm. The updated algorithm has been simplified, using assumed aerosol microphysical properties to infer the aerosol extinction at a single wavelength (674 nm) based on the limb scattered radiance. This retrieved aerosol extinction profile is then used to compute radiances across the OMPS LP spectrum, which can be compared to the OMPS LP measurements to assess the consistency of the assumed aerosol microphysical properties and retrieved extinction values. Initial assessment of the radiance residuals at several wavelengths will be presented.

3-58   Use of GEONETCast Americas by the Belize Meteorological Service
Author: Dwayne Scott

The National Meteorological Service (NMS) of Belize is a small department within the Government of Belize that provides meteorological and climate-based products and services to the Belizean public and is a necessary support to the operation of the only international Airport in the country the Phillip Goldson International Airport. The products and services are provided through accurate monitoring and data collection, reliable data analyses and timely dissemination of user-friendly information on regular and emergency events and processes. To provide these services the NMS relies solely on information gathered via the internet. All numerical weather prediction(NWP)models such as, GFS, NAM, NAVGEM, all satellite imagery and satellite derived products, as well as all surface observations local and international are gathered through our internet service. In addition to this Bulletins and Discussions from the National Hurricane Centre and the Hydro-meteorological Prediction Centre (HPC) are received via the internet. Therefore in the event of internet failure the NMS would not be able to function in providing the necessary weather products to its stake holders. Over the past 10 years the NMS has suffered periodical internet disruptions varying from a couple hours to 1-3 days which have severely hampered operations. However during those times the NMS had a means of gathering data via Satellite through METLAB. However with METLAB now becoming an internet based system the need for reliable Satellite systems able to gather all data needed for daily operation has become extremely important. The NOAA Satellite Conference therefore will provide the means by which the NMS can be informed on:
1. the various satellite services available
2. expected changes in future technologies
3. steps to be taken to properly implement need systems

3-59   Low Cost NOAA Satellite Signal Receiver for the Characterization of Astronomical Sites
Authors: Gary Flores, Ericson Lopez, Luis Tituaña, Edwin Mena, Daniel Vera & Enrique Lascano

Modern astronomy, with technologically advanced instruments, require significant financial resources both for installation and for operation. Equipment require to be located in places with high sky quality to ensure the highest possible number of clear days, thus allowing full advantage of the investment.

In a world of increasing light pollution, air pollution and electromagnetic contamination, transparency measurements and atmospheric stability are essential for astronomical practice.

In this context, the Astronomical Observatory of Quito has developed an electronic system that consists of a

digital tuner that employs an AD converter (analog-digital) and an external antenna to receive signals from NOAAS satellites. The tuner possesses high sensitivity to weak signals and using SDR (Software Defined Radio) software to display the frequency responses, it is able to work as a frequency spectrum analyzer for frequencies less than 1.7 Ghz.

This analyzer was used to study the physical conditions of a couple of sites where astronomical instrumentation is expected to be installed. We were able to determine the grade of electromagnetic contamination, to define the quality of conditions for astronomical observations and whether it is appropriate to work at a specific frequency. The results obtained for characterizing the sites were also based on a significant number of exploratory trips and a detailed analysis of cloudiness (NOAA satellite images).

3-60   Suomi NPP CrIS and Metop IASI Sounding Validation

Authors: William L. Smith Sr., Allen Larar, Henry Revercomb, Elisabeth Weisz & Joseph Taylor

The operational CrIS and IASI instruments aboard the Suomi-NPP and Metop-A/B satellites, respectively, provide a broad spatial coverage (~ 2200 km, in the cross track direction) of radiance spectra from which the thermodynamic and chemistry structure of the atmosphere can be defined with 15-km horizontal resolution. Dual-Regression (DR) retrievals, which benefit from the full information content of the measured radiance spectra, are used to validate the accuracy and potential forecast utility of the satellite sounding observations. Trace gas concentrations, as well as temperature and water vapor profiles are produced. A physical radiative transfer solution of the surface emissivity spectrum and correction for statistical bias of the regression retrieval enable surface and atmospheric profile features to be retrieved with high accuracy.

Suomi NPP CrIS and Metop IASI sounding retrieval accuracy and potential forecast utility have been validated through the analysis of data obtained during three airborne campaigns: the 2013 S-NPP Cal/Val-1 conducted over North America and surrounding waters, the 2014 NASA Hurricane and Severe Storms Sentinel (HS3) campaign held over the North Atlantic, and the 2015 S-NPP Cal/Val-2 campaign held over the Greenland/Iceland Arctic region. Dropsonde, radiosonde, and aircraft remote sensing data were used in the validation studies. Results are presented which demonstrate the sounding retrieval accuracy and potential forecast utility of the S-NPP CrIS and Metop-IASI data are presented.